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ENGINEERING NEWS-RECORD

A McGRAW-HILL PUBLICATION — ESTABLISHED 1874

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

F. E. SCHMITT, *Editor*

Volume 103 NEW YORK, SEPTEMBER 26, 1929 Number 13

A New Chief Appointed

NOMINATION of Gen. Lytle Brown to be Chief of Engineers was made last week. The nomination was not unexpected. It had been rumored for weeks. Nevertheless, it is a most unfortunate deviation from established policy, as was pointed out in these pages recently. Not that anyone doubts General Brown's ability to fill the office of Chief of Engineers ably. His ability is not in question. The question is as to whether any possible advantages to be gained by bringing in an officer from outside the Corps to become its Chief will offset the demoralizing effect of such a movement on the whole Corps, and especially upon the ten officers at the head of the Corps upon whose records the appointment stamps the unpleasant epithet "Incompetent." We do not think it possible for the ability of any one man to compensate for the effect of that action. Moreover, now that the President has announced his intention of decentralizing the work of the Corps the reason for this unusual appointment is less evident than it was a few weeks ago when first rumored.

Decentralized Control

CONTROL of the work of the Corps of Engineers is to be decentralized, according to a brief announcement made at the time the nomination of General Brown to be Chief of Engineers was announced at the White House. Such a move is in line with President Hoover's known desire to check the present tendency to concentrate all control of government operations in Washington. The proposed change is not without its obvious advantages in the light of the manner in which the former Chief of Engineers overruled the recommendations of his subordinates in a number of instances and completely sidetracked the recommendations of the Mississippi River Commission, until then an independent body having decentralized control such as the President now proposes. From what can be judged from the President's statement, the Mississippi River Commission is to be restored to the independent status taken from it by the flood-control act of 1928. Why a man of General Brown's special characteristics was chosen for the position of Chief of Engineers rather than for that of President of the Mississippi River Commission under the proposed arrangement is therefore not clear. Nor is it clear why the work on the tributaries of the Mississippi and that on the waterways from the Great Lakes to the sea were singled out as being of such magnitude as to warrant the same sort of independent control which is to be set up for the Mississippi River work. Possibly there is some connection between this proposal by the President and the report published more recently in Chicago to the effect that he would push work on the Lakes-to-Gulf waterway. The speech of the Secretary of War before the Atlantic Deeper Waterways Association on Thursday may also have more significance in this connection than is usually attached to such speeches before partisan groups. But aside from these instances, more light is needed upon the proposal before it becomes evident why any work except the Mississippi flood control is so much more significant than other divisions of the Corps' work to warrant granting greater independence to the officers in charge than is now granted to division engineers. It is to be hoped that the President will soon expand his views on the subject.

A Tunnel and Caisson Code

A TENTATIVE draft of a tunnel and caisson safety code will be voted on for final adoption at the National Safety Congress next week in Chicago. Such a code is desirable, not as a club to hang over the heads of underground contractors, but as a guide to common-sense safety practices on an unusually hazardous class of work. Parts of the code have been taken from New York City's compressed air laws, which have done much to reduce the former heavy fatal toll of caisson disease or "bends" to a degree where a fatality is now rare. There is nothing in the proposed code that will work a hardship on the contractor. On the other hand, it cannot be said that following the code will automatically abolish all accidents. No two construction jobs are alike and each has its own peculiar problems. But the code is sufficient to point the way to safety practices that, when mixed with a little common sense, will suffice for all situations. Furthermore, a sane code approved by the National Safety Council will serve as a pattern for legislative bodies that are bound to frame safety laws throughout the country regardless of whether or not the construction industry approves of them. The lack of such a pattern might result in much unwise and illogical legislation.

A Troublesome Question

LIKE many other acts, bathing is commendable but only when done in a proper place. Offhand, one would say that any body of water used for human consumption is not such a place. A number of our state legislatures have taken that view and declared the practice illegal. Unfortunately, such legislation is sometimes too vaguely sweeping to be readily enforceable. Here as in many other matters made the subject of legislation designed to protect the public health, careful attention must be given to varying degrees of danger and the certainty that some day the courts may rule that an application of the prohibition to a specific case is unreasonable and will not be upheld. A sweeping Connecticut statute on this subject has been upheld by a lower state court so far as legality is concerned, but the court ruled that enforcement rested elsewhere and the case is now on appeal to a higher court, as stated in our report of the convention of the New England Water Works Association, elsewhere in this issue. This general subject is always fruitful of discussion when it comes up at a water-works convention.

While it may not bring out as many viewpoints as there are speakers, it generally gives rise to great divergences of opinion. Analysis will usually show that these divergences come from having in mind quite different conditions—as the number of actual or probable bathers, the distance of the bathing place from a water-works intake and the volume of water affected and the absence or existence of water purification and, if any, its nature. All these and other factors enter into the danger involved and are certain to be considered by a court if the case for defendants is well presented. It must be remembered, too, that the bathing public and even more strongly the riparian owners feel that they have certain rights in public waters, especially those provided by nature with little or no aid from municipalities or water companies; and that they also feel that water authorities can protect their supplies by treatment, especially when the dangers of pollution are small at the start and lessened by distance, time and dilution. Legislation on this subject needs far more attention than it generally receives before it is enacted.

Manhattan's Freight

AGREEMENT between the railroads serving the port of New York and the Port of New York Authority providing for the joint use of a large inland freight terminal on Manhattan Island marks a notable advance toward improving freight handling within the city of New York. If this first inland freight terminal is a success, others will be built by the Port Authority. Primarily these new terminals will be city facilities rather than port facilities, but by taking away from the waterfront the handling of much freight destined for industrial use within the city, they will serve the port by releasing waterfront areas for more essential port purposes. No rails will enter these terminals. All the incoming freight is to be brought to them in the railroad companies' trucks from rail terminals across the river in New Jersey and outgoing freight will be collected at the terminal, classified and consolidated as far as possible for carload and part-carload lots and sent across the river for shipment. Under this arrangement much of the present movement of partly loaded trucks is expected to be avoided. In the end it may well be that the change will result in a substantial improvement of traffic conditions in many parts of New York City.

Equipment Thinking Lacking

IN SPITE of the widespread use of mechanical equipment that characterizes all modern construction, much of it is not being used as efficiently as might be. Few engineers or contractors, when thinking in terms of equipment, display the intelligence and analytical acumen that characterize their thinking on other subjects. Few apparently do any thinking at all in terms of equipment. At recent meetings of the American Society of Civil Engineers, committees of the Construction Division have made reports on the general subject of construction plant and methods as used on highways, steel buildings, hydroelectric plants and concrete bridges. By and large the reports have been good and give excellent promise of uncovering some important fundamentals in the use and arrangement of equipment on construction work. But when it comes to securing the co-operation of the membership at large in discussing and criticising the reports by letter, practically nothing is forthcoming. Indeed, one might assume that there is no interest in the subject. A more likely assumption is that many contractors and engineers do not regard the use, arrangement and purchase of equipment as a task requiring more than ordinary intelligence and that thinking expended on it is somewhat a waste of time. The situation is not one to arouse optimism regarding contracting efficiency in this machine age.

The Volunteer Adviser

ALONG with the call to public service which has come to the engineer since the war, and largely by reason of the tremendous publicity the profession received during that period, came innumerable opportunities and importunities for engineers to serve on civic committees. Since then, extensive experience has shown that many a pitfall lies in the path of the engineer who innocently accepts such service out of a feeling of responsibility to discharge his duty of citizenship. Impressed by the layman who emphasizes this civic duty, the engineer may easily find himself enlisted in service on a committee to produce a report that would involve half a year's hard research if the same problem were turned into the average consultant's office.

Nicholas S. Hill, Jr., recently said in a paper before the American Water Works Association that the engineer who when working on his own initiative is cautious in his statements and confines himself to fields in which his personal knowledge, experience and professional reputation qualify him to speak takes quite another attitude when working on a civic committee. He then is prone to go outside his own field and to speak with too much confidence and too little knowledge. The average citizen is likely to think an engineer is competent to advise on any engineering problem regardless of his specialty, and holds that if service can be obtained gratuitously it is unnecessary to find money for professional work. The danger of error that resides in these conditions is so plain that the engineer can do no greater service to his profession than to admit his lack of knowledge on specific questions and advise his fellow citizens to engage competent service. He need not fear to depreciate himself by so doing; rather, he will create greater confidence in his profession.

There is a distantly related phase of civil service that invites notice here. For some time past a few consultants have been reluctant to engage on municipal work where there are engineers in place of the usual laymen among the city officials. The type of engineer who seeks civic honors, it is held, is often not one who appreciates and insists upon the best engineering talent. As an official he is captious, unduly critical of insignificant details and generally lacking in appreciation of the fact that by so doing he is lowering confidence in his profession. It is unfortunate that such a condition should arise, or even appear to arise. The cure lies in a truer understanding among engineers of their proper function in governmental affairs.

Societies also are constantly being called upon by civic bodies to handle public questions. The easiest thing to do is to appoint a committee and expect professional advice that should be based only on research entirely too voluminous and expert to be given without remuneration. The Western Society of Engineers, for example, has been called upon so often for just such service that it has evolved a definite procedure, which so far has proved fairly satisfactory to all concerned. It frankly tells the civic body that while the question is one of civic duty,

yet engineers of the character needed, like lawyers of good repute, should not be asked to work without pay. It then states that it has among its members men qualified to do the special task and will if desired submit a small list of names from which a choice may be made. By this action the society serves its community better and it does so with much more effectiveness and less fear of criticism than can the individual engineer.

The engineer himself, like his society, can do much by his actions to maintain a spirit of justice to the profession and high regard for its ethics. He ought never to disregard or undervalue his privileges and duties as a citizen, but in fulfilling these duties his actions should be guided by broad consideration of that which in the last analysis will best serve the community.

Flood Protection by Diversion

THERE are remarkably dramatic elements in the Mississippi flood-control project which set it apart from most other great construction enterprises. The diversion floodways, about which the drama mainly centers, are brought to the front of the scene by the outline of side-channel structures and hydraulics which is completed in this issue with the description of the Atchafalaya floodway. The four floodways (Missouri, Boeuf, Atchafalaya and Bonnet Carré) which have been described are by far the largest use ever made of side-channel diversion for flood-protection purposes. Indeed, diversion characterizes the Mississippi project, for the levee raising and reconstruction is concededly only a halfway measure and stabilization by revetment is experimental, while the diversion is relied on as lastingly positive and certain in its operation.

Of the four diversion channels, the Missouri and the Bonnet Carré are primarily designed to lower the flood peak for local protection—the city of Cairo in case of the Missouri floodway and the city of New Orleans in case of the controlled spillway and diversion leveees at Bonnet Carré. The major main-river diversion, virtually a twin channel from the Arkansas River over 300 miles in direct line to the Gulf, is provided by the continuous valley of the Boeuf, Tensas and Atchafalaya rivers. The Boeuf basin and the Atchafalaya floodways therefore dominate attention in the diversion plans for Mississippi floods.

Beginning at the mouth of the Arkansas River and continuing on to the Gulf, the crest flow of the great floods is to be kept out of the natural channel of the Mississippi and is to pass down the valley through leveed strips of basin country in a volume increasing from a trifle less than a million second-feet to half again as much below the Red River. The Boeuf River basin is the upstream half of this diversion channel; at the Red the waters are transferred to the Atchafalaya and two paralleling floodways.

This great mass of water, ranging from one-third to one-half of the maximum possible superflood estimated by the army engineers, is virtually equal to the whole flow of the river in a normal flood. That is to say, it is a flow which is a formidable source of anxiety even when confined within the well-scoured and amply leveed river channel. It may reasonably give rise to even more anxiety when it passes down the diversion channel. Flowing water in great masses usually has ways of its own, and often disappoints advance expectations.

A non-permanent diversion channel is something whose behavior and value remain to be learned. For indefinite periods of time the channel is to remain empty of water, and (in the conception of the former Chief of Engineers) is to be lived in, farmed and perhaps utilized industrially. Then, when a great flood washes out its head levee, as is specifically intended, this same strip of land is to carry off a flow of a million second-feet—four times the flood flow of the Ohio at Cincinnati—in a shallow sheet a dozen miles wide. This is something new in hydraulic experience. The service records of these floodways in future years will therefore be of great interest and may be expected to write new chapters in the book of practical hydraulics.

But further, the Boeuf-Atchafalaya diversion is in large measure at the bottom of the controversy that has made the Mississippi project a fighting matter for two years past and promises to keep it such for some time to come. Questions of sound engineering as well as questions of human justice are involved.

The notorious difference between the Mississippi River Commission plan and that modification of it which General Jadwin put forward, a difference between some seven hundred million dollars and the Jadwin figures of $296,400,000, has some of its reason in the respective widths of floodway. The commission had chosen a moderate width and rather high confining levees, in view of floodway land cost: General Jadwin, asserting that the floodway lands would not be damaged, chose a much greater width and lower levees. The planning process ignored the prime requisite of all engineering planning by taking no account of losses and gains—whether a wider floodway would be justified, in view of the greater area of land hazarded and smaller area protected.

And so also the matter of human justice enters; for the army engineers, along the river, under General Jadwin's direction, have proceeded with detail plans of the floodways and were preparing to let contracts regardless of the wholesale destruction of property values that might blight the lands in the channel—until the court stopped them, in an action now up for decision.

Meanwhile, Attorney-General Mitchell had made his remarkable decision of July 19 (see *Engineering News-Record*, Aug. 1, 1929, p. 186) to the effect that the President is powerless to do anything about the project; the War Department having been directed by Congress to execute a prescribed plan, he cannot change it or inquire into it. The Chief of Engineers has changed the plan; a map taken from the Jadwin report of 1928, which was the adopted basis of the act of Congress compared with the present floodway levee maps, shows that profound changes have been made. Yet under the curious opinion of Attorney-General Mitchell, the President is powerless to inquire into the propriety, safety or economy of these changes. The President may not change the plan, but one of his subordinate bureaus changes the plan and he may not even inquire into the matter!

It remained for the President to provide the climax of the play by interfering after his Attorney-General had said he could not. True to dramatic values, he announces that the floodway work in the Boeuf-Atchafalaya basin may be held up until the interested valley states shall thresh out the dispute and come to an agreement on a plan and procedure. At present in its informal expression the decision seems to toss the whole question again into the air, but probably we may expect that official orders will carry a definite program for action. At least the people of the Mississippi Valley have evidence that bureaucratic administration has not yet come to the fine flower indicated in the decision of the Attorney-General.

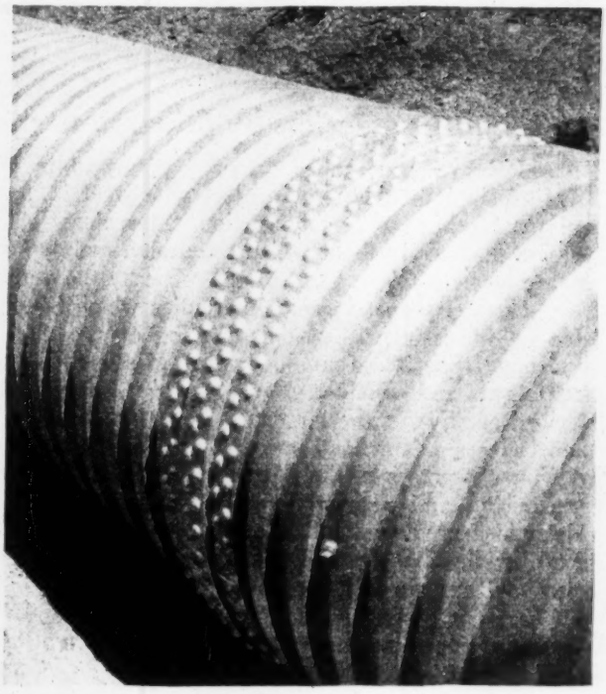
Providing for a 2,418-Ft. Head in the Big Creek 2-A Penstock

Features of Design and Construction—Single Line Includes Riveted, Banded and Forged Pipe to Carry 540 Sec.-Ft.

By H. L. Doolittle
Chief Designing Engineer, Southern California Edison Company

DESIGNED for a static head of 2,418 ft. and a maximum capacity of 540 sec.-ft., a single penstock serves the two 56,000-hp. impulse units of the Southern California Edison Company's 2-A plant at Big Creek. The economy of this design resulted from flow conditions that make the plant inoperative a part of each year and from the use of seamless forged steel pipe for the portion of the penstock having a head of more than 1,642 ft. These pipe sections are forged from steel ingots and machined to dimension, the thickness reaching a maximum of 3 in. at the bottom of the line. Above the forged pipe a portion of the penstock is constructed of banded pipe and in the upper division quadruple-riveted pipe is used.

Operating entirely on stored water, the 2-A plant will be shut down for several months each year. This will permit periodic inspection or repair work to be done on the penstock and resulted in the study of the possible economy of a single pipe line. For the high head and the large quantity of water at this plant a single penstock was considered practicable only through the use of seamless forged pipe which is now made of practically any diameter and thickness in this country.



BANDED PIPE JOINT
Joints are formed by riveted butt strap machined to fit.

BIG CREEK 2-A PENSTOCK

Penstock calculations were based on three types of pipe-line construction: riveted, banded and seamless forged pipe.

Determination of the sizes and amounts of the various kinds of pipe to be used, in addition to the choice of a single rather than a double penstock for the plant, followed the method that bases penstock design on the minimum total yearly cost, including interest, depreciation on the installed cost and the value of the power lost in friction. The results as shown by the accompanying curves indicate that a single penstock would effect a yearly saving of $36,000 and a reduction of about $200,000 in initial cost. The single penstock was adopted and the design was based on the following figures:

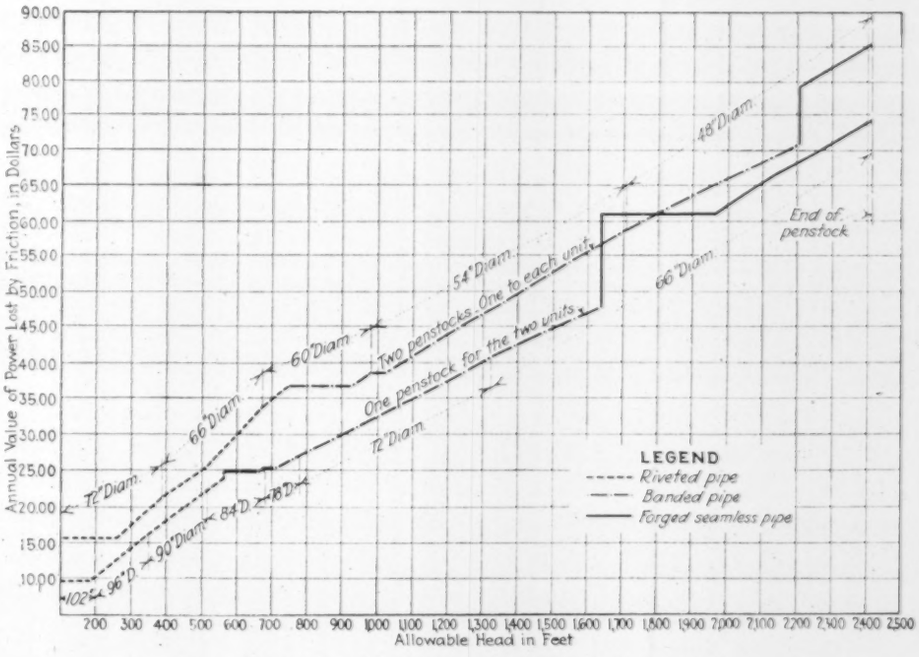
	Kind of Pipe		
	Riveted	Banded	Forged
Maximum stress (lb. per sq.in.)	10,000	10,000	12,000
Minimum plate thickness, in.	½	1¼	2½
Maximum plate thickness, in.	1¼	2½	
Value of n (Kutter's formula)	0.016	0.012	0.012

Average flow, 375 sec.-ft. Maximum flow, 540 sec.-ft. for two units.

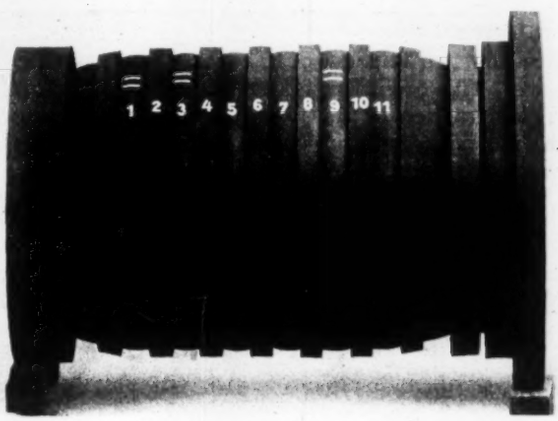
The limiting pipe thicknesses are mainly arbitrary figures resulting from the company's experiences and from practical consideration. Banded pipe heavy enough to resist the stresses at the bottom of the penstock might have been obtained, but as this pipe would have been heavier than any banded pipe manufactured up to that time it was considered advisable to stop the banded pipe at a thickness of 2½ in. and use the forged

pipe for the remainder of the line. In all cases the banded pipe is referred to in terms of equivalent thickness, meaning the thickness of ordinary pipe having the same area per foot of pipe as the combined area of the bands and the shell of the banded pipe. Calculated thickness of the riveted pipe was increased $\frac{1}{16}$ in. to provide for possible corrosion of the steel.

No provisions were made for excess stresses due to water hammer, as the low unit stresses adopted gave thicknesses that were considered ample to resist any increased pressure from this cause. Banded and forged pipe were designed by the use of Birnie's formula for thick cylinders.



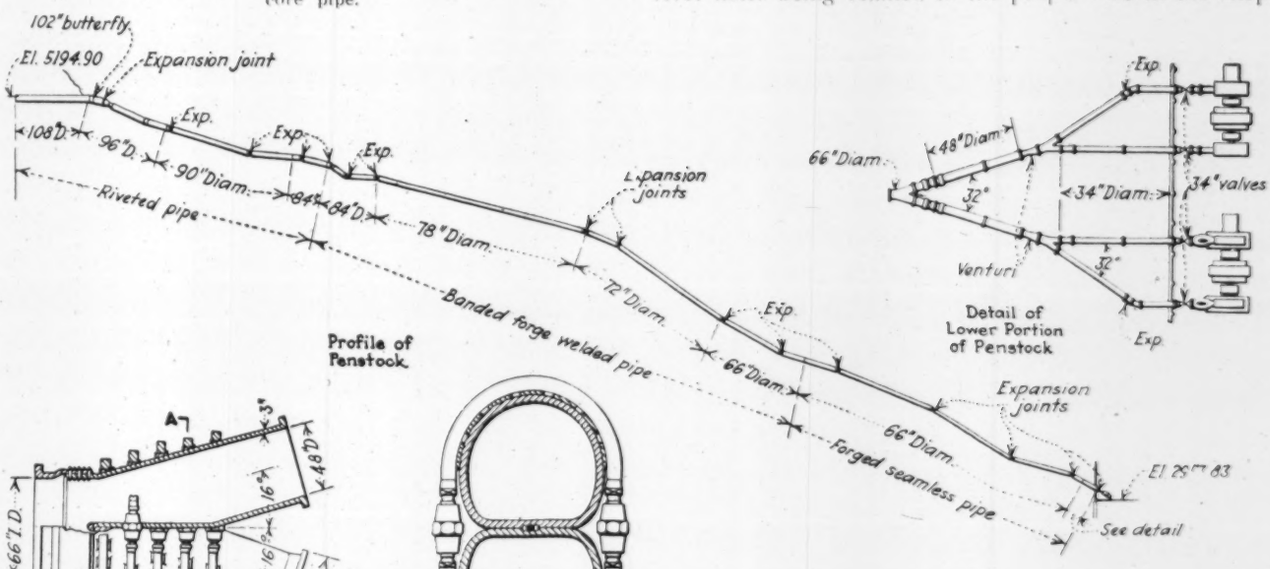
GRAPHIC STUDY OF PENSTOCK ECONOMY

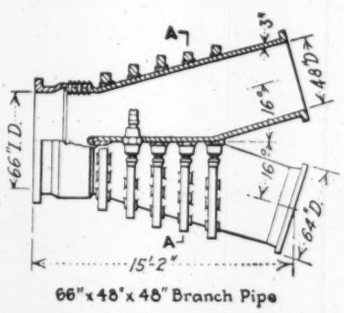


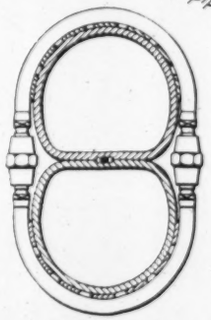
BANDED PIPE TESTED TO FAILURE
Failures are indicated by white lines showing splitting of core pipe.

As designed, the pipe line consists of: 1,858 ft. of quadruple-riveted pipe varying from 108 to 84 in. in diameter and from $\frac{9}{16}$ to $1\frac{3}{16}$ in. in thickness; 3,042 ft. of banded forge-welded pipe varying from 84 to 66 in. in diameter with a thickness of $1\frac{1}{4}$ to $2\frac{1}{2}$ in.; 1,764 ft. of seamless forged pipe, practically all 66 in. in diameter with thickness varying from $2\frac{1}{2}$ to 3 in.

The banded pipe consists of a lap-welded core pipe with seamless forged steel bands shrunk on the outside. Spaces between the bands are about equal to their width, giving a weight of metal in the bands approximately equal to the core pipe. All the bands are machined on the inside to the proper diameter for a shrink fit. The field joints between the banded pipe consist of an outside butt strap of seamless forged steel machined to a taper fit on the pipe. This joint is double riveted, the rivet holes being reamed to the proper size in the shop.

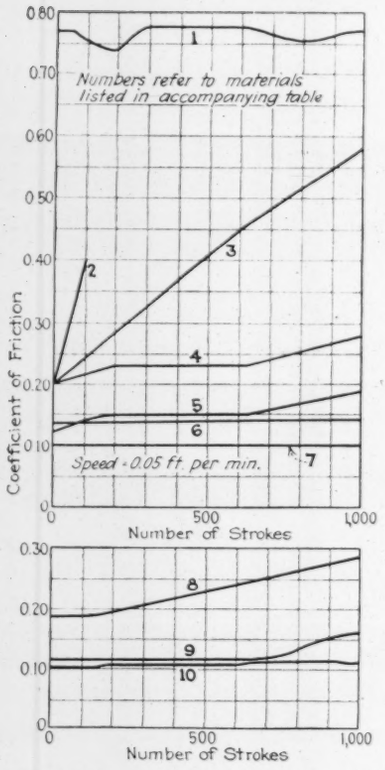






PROFILE AND DETAILS OF PENSTOCK

Manufacture of forged steel pipe of this size is of unusual interest. Field handling required a limiting weight of 25 tons for each pipe, resulting in sections between 25 and 30 ft. in length. These sections are made from a solid cast-steel ingot about 7½ ft. in diameter, weighing approximately 150 tons. After discarding a 25-ton piece from the top, the ingot is cut in two and each half is forged into a section of pipe. The ingots are first pierced with a 34-in. diameter hole and are then forged over a mandrel. Because of the difficulty in forging a thin section and the loss from scale, about 3 tons of ingot was required to produce 1 ton of finished pipe. After forging, the rough pipe is mounted on a boring mill and machined to proper dimensions. Since forgings of less than 5-in. thickness are impracticable, a large amount of machine work is involved in finishing each section of pipe. These pipes have integral forged flanges with the face of the flange grooved for a $\frac{7}{16}$-in. round gutta percha gasket and are connected in the field with bolts designed to take the full hydrostatic thrust.


Coefficient of Friction
Numbers refer to materials listed in accompanying table
Speed - 0.05 ft. per min.
Number of Strokes
Number of Strokes

FRICTION TESTS OF MATERIALS FOR JOINT BETWEEN PIPE AND PIER

Each section of banded and forged pipe was tested to double static pressure in the shop and, with the low working stresses adopted, these test pressures stressed the metal to a point well below the elastic limit. The riveted pipe was not tested in the shop, because of the difficulty of making tests and the reliability of this type of pipe to withstand the comparatively low pressures at the top of the penstock.

Before the banded and forged pipe were manufactured one section of each was tested to destruction; the results of these tests are shown in the accompanying table.

All supporting piers along the penstock line are made of concrete except a few of such a height as to warrant structural steel. Many tests were made to determine the most suitable type of material to be inserted between the pier and the pipe to reduce friction. The tests were made by a machine using a reciprocating motion with a unit load considerably greater than the actual pipe load to take into account the possibility of damage to the material by abrasion during use. As a result of the tests, a $\frac{1}{16}$-in. packing was used composed of heavy compressed asbestos sheets thoroughly impregnated with graphite. Two of these sheets are used at each bearing point, one piece being cemented to the pipe by red lead and the other cemented to the top of the concrete pier.

RESULTS OF TESTING PIPE TO FAILURE

		Banded Pipe 66 In. Dia. 2½ In. Thick	Forged Pipe 66 In. Dia. 3 In. Thick
Test pressure at yield point, lb.		2,770	2,150
Test pressure at failure, lb.		3,930	5,300
Calculated stress at yield point, lb. per sq. in.		37,000	25,000
Calculated stress at failure, lb. per sq. in.		54,000	62,000
	Core	Band	
Yield point, lb. per sq. in.	38,600	43,300	27,000
Ultimate strength lb. per sq. in.	51,200	78,700	67,750
Reduction in area, per cent	51.5	48.9	41.5

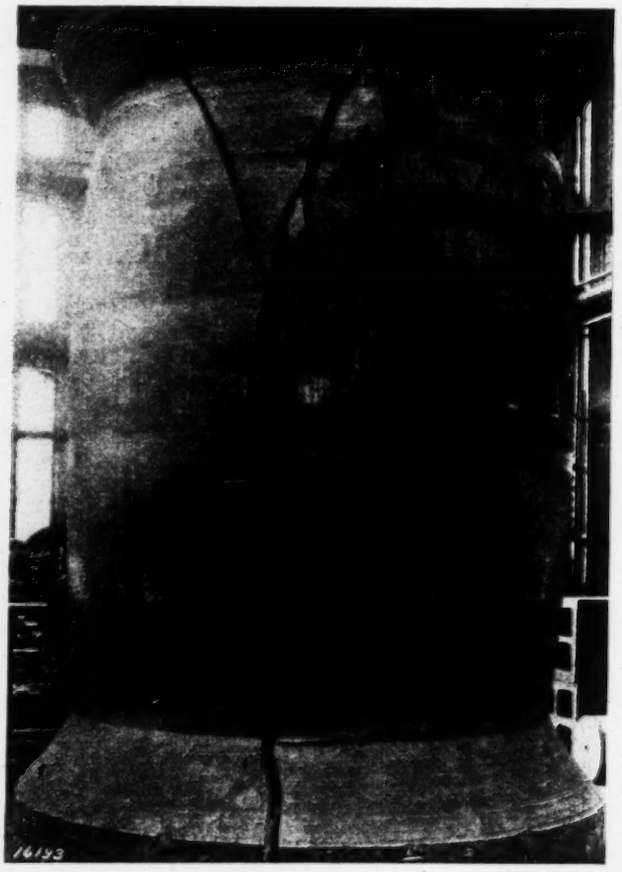
MATERIALS TESTED FOR JOINT BETWEEN PIPE AND PIER

Numbers refer to results of tests shown in accompanying drawing

No.	Load, Lb. Per Sq. In.	Materials
1	100	Steel on concrete, dry
2	86	Brass on lead, dry
3	100	Steel on rough cast iron, dry
4	100	Steel on machined cast iron, dry
5	100	Steel on machined cast iron, lubricated
6	100	Steel on concrete, lubricated
7	86	Brass on lead, lubricated
8	86	Compressed asbestos sheets impregnated with graphite
9	100	
10	150	

Design of the anchors followed ordinary practice, care being taken, however, to locate expansion joints either above or below, and in some cases, above and below the anchor in order to give a minimum resultant thrust. Anchors are all designed to withstand a force due to expansion and contraction of the pipe, based on a coefficient of friction of 0.5 for sliding on top of the pier. This coefficient is considerably higher than the factor determined by the tests, but it was used because of the possibility that the coefficient might increase over a period of years.

All bends used in the line were of seamless forged steel, practically all providing an expansion joint for



SEAMLESS FORGED PIPE TESTED TO FAILURE

the pipe. At these points the pipe is copper plated where it comes in contact with the packing. Square flax packing was used in all joints.

At the lower end of the line it was necessary to provide four pipe branches, since the single penstock operates two units, each having two waterwheels. The main line of 66-in. diameter branches into two 48-in. pipes, which, in turn, are provided with Y's, reducing to two 34-in. branches that lead to the nozzles of the waterwheels.

These Y branches were built in accordance with patented designs of the M. W. Kellogg Company. They consist of two tapering seamless forged pipes (see drawing) with the larger end forming a semicircle, riveted into a forged nozzle pipe. Heavy reinforcing bands made in two parts placed on the outside are held together by large threaded sleeves to take the thrust resulting from the flat surfaces where the two tapered ends are joined. This construction is shown by an illustration in *Engineering News-Record*, May 23, 1929, p. 848.

A 102-in. motor-operated butterfly valve is installed at the top of the penstock. This valve is arranged for remote control and also will close automatically, actuated by a mechanism from a Venturi tube, when the velocity in the penstock rises to approximately 100 per cent above normal. Immediately below the butterfly valve four pairs of 10-in. diameter air valves are installed for admitting air to the penstock when the valve closes.

The use of two 48-in. gate valves immediately below the first Y which would permit the repair of the valves at each waterwheel without shutting down the entire plant was abandoned, as these valves introduced an element of additional repair and upkeep. It was decided that, since the plant will be inoperative for several months each year, it would be permissible to eliminate these secondary valves. Adjacent to each waterwheel a 34-in. hydraulically operated gate valve is installed that may be closed by remote control from the switchboard.

The riveted pipe was furnished by the Western Pipe & Steel Company; the banded pipe was furnished by the Ferrum Company, of Poland; and the forged pipe was supplied by the Midvale Steel Company and the Bethlehem Steel Company. Design of the penstock was done in the engineering department of the Southern California Edison Company and erection was carried out by the construction forces of the company.

Rapid Warehouse Construction by Standard Methods

Careful Planning of St. Louis Building Results in High Quality and Low Cost—Contractor Advises on Design

By John F. Miller
Consulting Engineer, New York City

THOROUGH planning and execution of design and construction by well-known methods gave very satisfactory results in the construction of a large distributing warehouse in St. Louis, Mo., for the J. C. Penney Company. The building, 367x180 ft. in plan, contains thirteen floors, with one-third of the ground area of 66,000 sq.ft. devoted to basement and sub-basement. It is of the reinforced-concrete flat-slab mushroom type with no drops or caps on exterior columns. The exterior is of red pressed brick veneer. All stories are 12 ft. in height with the exception of the first floor (16 ft.) and the top floor (14 ft.). Columns vary in diameter from 34 to 16 in. Steel required for the main portion of the building totaled 2,640 tons, for walls and footings 207 tons. Similar figures for concrete are: main portion, 30,200 cu.yd.; walls and footings, 6,300 cu.yd. With the exception of offices on part of the top floor, the entire building, containing almost 900,000 sq.ft. of floor area, will be used for warehouse purposes. Auxiliary equipment includes eleven large freight elevators, two high-speed passenger elevators (with hatchways provided for another), a complete sprinkler system, conveyors, elevators and spiral chutes to handle merchandise and a central station watchman service, fire alarm and paging system.

Foundations—Examination of soil conditions at the site disclosed a bed of yellow clay extending over the entire area approximately 30 ft. thick. Below this were alternate layers of quicksand, clay and small boulders down to solid rock from 65 to 70 ft. below the surface. Loading tests indicated that the clay, if not penetrated too deeply, would support the building but that if it was cut through to the depth required for a basement it would leave too thin a stratum to carry the load. Under such conditions, it would have been necessary to sink footing to rock, an operation more expensive than the value of the basement to the business. For this reason basement and sub-basement area was finally limited to an amount just sufficient to house the mechanical and operating equipment, supporting this portion on precast reinforced-concrete piles driven to refusal into a boulder stratum just above rock. The remainder of the building was placed on individual spread footings resting on firm clay.

In deciding upon this method of construction it was expected that cracks would appear along the dividing line between the two types of foundation, but it was felt that these cracks would not cause material weakness or interfere with operation or safety. No cracks, however, have appeared to date.

Concrete—Live loads were set at 150 lb. per square foot with the exception of the fifth and sixth floors, which were designed for 200 lb. per square foot. A 1 : 1 : 2 mix was used for the interior columns up to the fifth floor; above this point the mixture was 1 : 2 : 4. The latter was also used for slabs and beams. Ten per cent by volume of an approved admixture was added to the concrete, resulting in greater ease of mixing, handling and placing. The concreting plant consisted of two ¾-cu.yd. mixers located in a pit, above which were mounted sand and gravel bins fed by bucket elevators. Concrete was distributed by means of two steel towers spouting into portable hoppers set on the forms and was conveyed to the required location in buggies. Unusual care was exercised to secure uniformity in mixing and placing the concrete and in placing the steel reinforcement.

That the concrete was of unusually high quality is shown by the results of cylinder tests summarized in the accompanying table. As a further check on results, four months after the second floor was poured a test load was placed on one panel with an area of approximately 260 sq.ft. (See Fig. 2.) Deflections were measured at the center of the panel and at the center of adjoining panels.

COMPRESSION TESTS ON 6x12 CONCRETE CYLINDERS

Age in days	7	8	9	10	11	12	14	18	28
No. of tests	6	1	1	1	1	2	17	2	13
Maximum	2,999					2,231	4,243	3,822	4,810
Average	2,506	2,231	2,543	2,670	3,292	2,112	2,885	3,639	3,697
Minimum	1,829					1,994	2,012	3,456	3,201

The load was increased by units of 50 lb. per square foot to a maximum of 450 lb. per square foot with practically no deflection.

Construction—Although some delay was experienced in the basement excavation due to rainy weather, once the first and second floors were poured a speed of better than a floor a week was maintained during the entire building operation. Some floors were poured in four days, working only one shift five days a week with very little overtime. The two $\frac{3}{4}$-cu.yd. mixers averaged more than 250 cu.yd. per day each.

The entire operation was carried on by the general contractor on a cost-plus basis at a cost considerably less than preliminary estimates based on actual unit bids received. Including the contractor's profit, all materials, forms, labor, overhead and other expenses, the concrete work cost a little less than 80c. a square foot of gross floor area. The final cost of the entire building, including contractor's profit, architect's and engineer's fees and all mechanical equipment except spiral chutes and conveyors, amounted to less than $2.70 a square foot of gross floor area.

Acting on the advice of the engineer, the general contractor was engaged even before the architect was secured, and he gave advice throughout on the design of the building. This was done because it was felt that the design should conform to economical construction demands as nearly as was feasible with operating requirements. The general contractor was selected on the basis of past work and reputation, rather than by a bid on this particular job. This same plan had been followed in the construction of a New York warehouse of the J. C. Penney Company built in 1925.

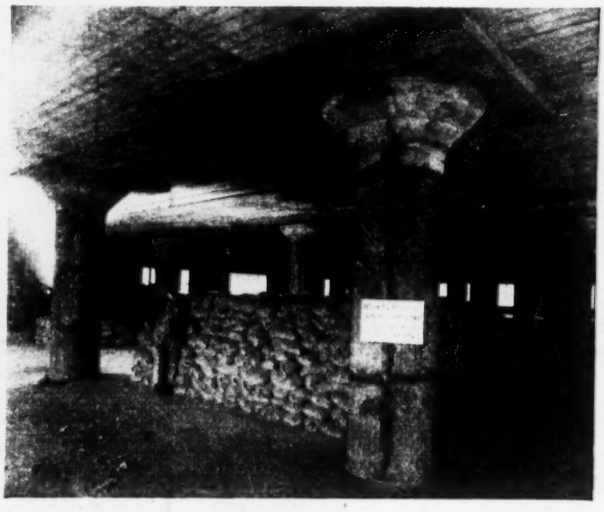


FIG. 2—TEST LOAD IN PLACE ON SECOND FLOOR PANEL

The work was in charge of the author, with the T. P. Barnett Company, St. Louis, Mo., associate architect. The structural steel and concrete were designed by Taxis & Becker, St. Louis, Mo., and the general contractor was Starrett Bros., Inc., New York City.

FIG. 1—ARCHITECT'S SKETCH OF NEW J. C. PENNEY WAREHOUSE IN ST. LOUIS

Lighter Structures

Two Articles on an Important Development in the Aluminum Industry

First Article: What the High-Strength Alloys of Aluminum Can Do

By Robert L. Streeter
Vice-President in Charge of Fabrication
United States Aluminum Company, Pittsburgh

LIGHT weight is one of the controlling demands of the time. In every field of mechanical production and use, the call is for less dead weight to be supported, fewer heavy parts to be handled and moved. Long ago the civil engineer demanded a lighter transit. Later the builder of high-speed engines sought lighter reciprocating parts. More recently the railroads have realized the economics of less car weight per passenger, and now the call for light weight comes from the structural engineer, who is troubled with the dead weight of cranes, large bridges and other works of construction.

Light metals have done remarkable service in meeting the demands of engineers in the past. They give promise of providing equal service to the structural and bridge engineer. During the past ten or fifteen years strong alloys of aluminum have developed to such a vast extent that they have opened up many new technological possibilities. As a result the aluminum industry has just entered into a most significant development, made possible by the creation of processes for rolling large-size structural shapes in these alloys. Extensive tests in both laboratory and practice have been made to determine and verify the value of riveted structural assemblages, made of strong aluminum alloys in place of structural steel.

Before these structural developments are discussed more specifically it will be of value to outline the development and present status of light aluminum alloys with respect to their production and use.

In the early days of commercial aluminum the silvery metal found use chiefly in kitchenware. It gained its place in this field by the same combination of qualities which has since extended its use to a vast number of larger industrial applications—namely, light weight, thermal conductivity and freedom from corrosion. Later its electrical conductivity—pound for pound much greater than that of copper—led to its entrance into the wire and cable field, and at the present time most long-distance transmission lines are of aluminum, usually in the form of an aluminum cable strengthened by a steel core.

Aluminum metallurgists early found that by varying additions of small quantities of copper, of manganese, of silicon, of magnesium and of other elements a series of remarkable new alloys became available. Best known of these is duralumin, or dural, as it is often called. Originally the name duralumin was applied to a specific alloy created in Europe, but now it serves as a generic name for the wrought strong alloys of aluminum. These, as well as some of the casting alloys—a decidedly different class—are subject to profound modification by heat treatment, which when properly applied enlarges their range of usefulness.

The new strong aluminum alloys have removed steel, brass and the older metals from many time-honored positions. Up to the present time more than 50,000,000 aluminum alloy pistons have been used in automobile and similar engines, and the trend continues to be toward aluminum and away from cast iron. As a further means of reducing the weight of the reciprocating parts, forged aluminum connecting rods are being used in place of steel. Cast aluminum crankcases, oil pans, transmission covers, differential carriers and many smaller parts may be found on many of the leading automobiles, while both forged and cast aluminum hardware have taken the place of brass. The change in nearly every case can be connected directly with the economic need for greater speed and the continual demand for higher operating efficiencies and lower operating costs.

Reduction in railroad running time, quicker pick-up

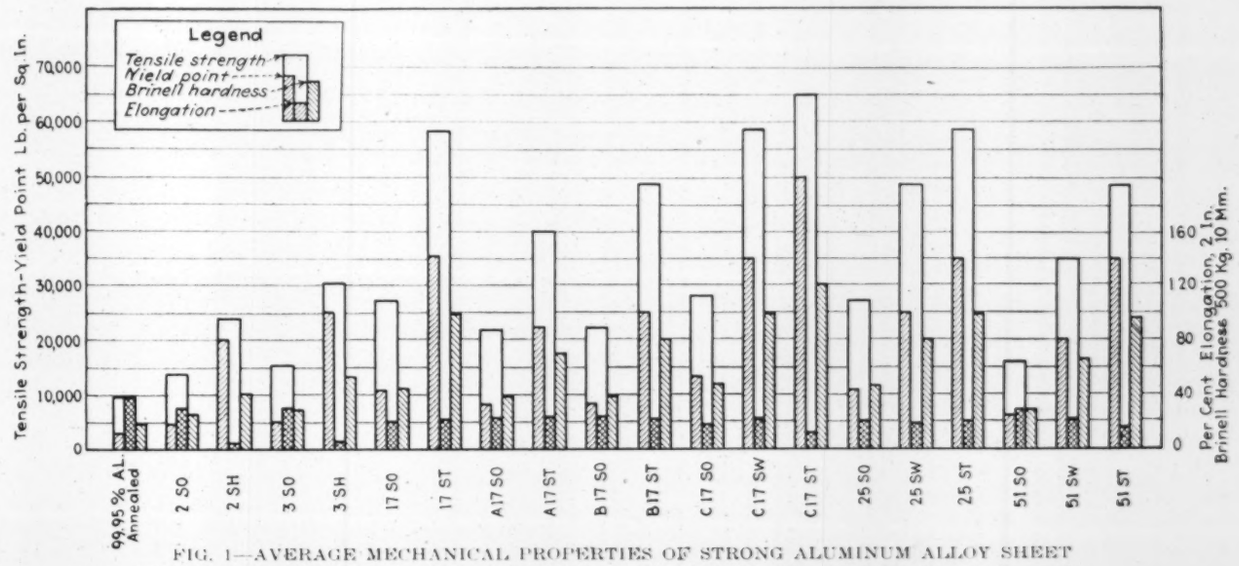


FIG. 1—AVERAGE MECHANICAL PROPERTIES OF STRONG ALUMINUM ALLOY SHEET
Guaranteed properties are slightly less. The last letter of the alloy symbol indicates the grade: O = dead soft; W = heat treated and quenched; T = aged, after quenching

on automobiles and greater acceleration on street cars are demands which bring about more extensive use of light-weight materials. What is true in transportation is in a measure true in all other fields of industry. The response to the demand for reduced dead weight is given by the new structural alloys of aluminum, which offer the sought-after combination of strength with lightness.

There are two distinct groups of aluminum alloys: the wrought alloys and the casting alloys.

Wrought Alloys

Six wrought alloys made by the writer's company serve the range of requirements from forged connecting rod or deep drawing to structural girder and airplane

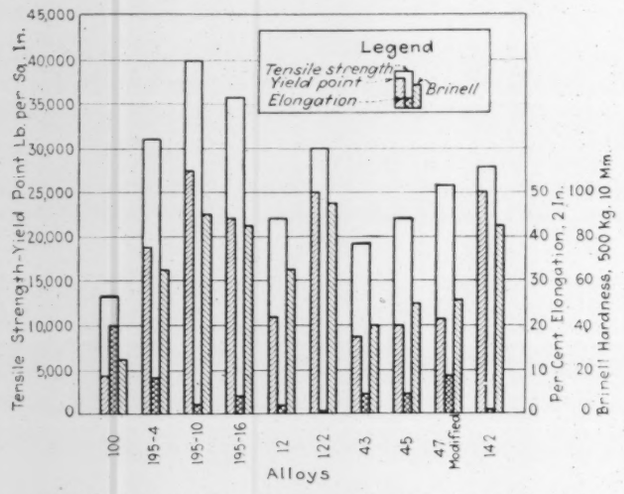


FIG. 2—AVERAGE MECHANICAL PROPERTIES OF ALUMINUM SAND-CASTING ALLOYS

Note properties of alloy 195 after heat-treatments 4, 10 and 16. Guaranteed properties are slightly lower than the averages shown.

use. All of these alloys may be thought of as duralumin. Actually, four of them are variations of the basic duralumin composition: they are 17S, A17S, B17S and C17S. A fifth, 25S, is commonly used for forged airplane propellers. The sixth, designated as 51S, is a material that forms readily cold and is used extensively in office chairs and similar furniture. In these three general classes of the wrought alloys we have a convenient summary of present commercial possibilities.

However, the important fact should at once be added that very decided modifications in the properties of some of these alloys can be made by appropriate heat treatment. The engineer who contemplates using any one of them for a specific purpose requires precise knowledge of these variations, and will usually find it advantageous to seek the technical advice of men trained in their use. Much can be done with these alloys, but to assure the best results and avoid disappointment or failure calls for an intimate knowledge of their characteristics under different conditions.

As an example of the variations possible, three of the alloys—namely, C17S, 25S and 51S—may be obtained in four tempers: soft, hard, heat treated and aged. These tempers are designated by the letters O, H, W or T added to the alloy number, and signify respectively dead soft or annealed (O), hardened by cold working (H), heat treated and quenched (W) and aged after quenching (T). For example, C17ST is the alloy C17S artificially aged after quenching. The three other 17S alloys are not obtainable in the quenched condition (temper W), because they age spontaneously at room temperature and assume the aged or T temper within a few days, although they are, as a matter of fact, treated and quenched after being manufactured.

A general survey of these wrought alloys in their various tempers is given in Table I, which also indicates the relative ease of forming. The second column of that table gives the order of stiffness, as rated by the cold-

TABLE I—GENERAL SURVEY OF THE WROUGHT ALLOYS OF ALUMINUM IN THEIR VARIOUS TEMPERS

Alloy	Order of Formability	Order in Relation to Increasing Radius for Cold Bends
51SO	1	1
51SW	5	3
51ST	11	9
25SO	3	2
25SW	8	6
25ST	10	8
17SO	3	2
17ST	*7 9	*5 7
B17SO	2	1
B17ST	6	5
A17SO	1	1
A17ST	4	4
C17SO		
C17SW	9	7
C17ST	12	9

*Shortly after quenching.

bend radius test: the low numbers here indicate the greater deformability, or the ability to bend to small radius or sharp corner. In this table the hard or H temper of each alloy is not given, because the physical properties obtained depend upon the kind and amount of cold working.

To follow through an example: Sheet metal of grade and treatment 51SW, readily workable by hammering or in dies and suitable for all but the most difficult forming jobs, may be chosen for a certain drawn shape. After fabrication has been completed, the metal may be artificially aged to gain in strength, yield point and hardness at but slight loss of elongation. (This aging, which transforms 51SW to 51ST, is effected at 320 deg. F., maintained twelve to eighteen hours.) However, should the work in question prove too severe for 51SW, it would be logical to start with dead-soft metal, 51SO. The severe cold working would then bring its strength and rigidity up to approximately that of 51SW metal, although its elongation will be low. Then, if greater elongation and strength are required, the finished part (51SH) may be heat treated (51SW), followed by artificial aging (51ST) if the highest physical properties are required.

Similar considerations with respect to working and treatment apply to the other alloys. In short, both the choice of alloy and the selection of method of working and treatment for any specific job depend on the character of work to be done and the physical properties desired in the finished piece.

Riveted and Welded Structural Work

Because of their superior mechanical properties, 17S and 25S alloys are most generally used in structural work. Each alloy has its own field of application, and the choice between the alloys depends upon the requirements which are to be met. At the present time such structural shapes as channels, angles, I-beams, etc., are either extruded or rolled; this is easily possible with the smaller sections. With the advent of large structural shapes, however, production considerations dictate the use of only the rolling process.

FIG. 3.—TRANSIT MADE ALMOST ENTIRELY OF ALUMINUM
Standards, top-plate and spindle die-cast integral. Total weight reduced over 40 per cent by use of aluminum tubing, forgings and castings.

Experience has indicated that in riveting structural members with hot steel rivets, the properties imparted by heat treatment are not adversely affected, provided certain simple precautions are taken. For example, in riveting a splice joint where the rivets are close together the rivets should be cooled immediately after they have been driven, or else they should be driven alternately. By driving first every other rivet and then the remainder the heat is not localized. Cooling can be accomplished either by an air blast or by water.

In highly stressed sections welding should not be employed, because of the fact that the material in the weld is of a cast structure and not as strong as the rolled, extruded or otherwise worked member. For sections not as highly stressed welding may be employed, the design and utility of the piece being the governing factor.

The Casting Alloys of Aluminum

Many aluminum alloys are available for casting service, and they vary widely in their physical properties. Those in general commercial use are confined to a relatively small number. In this field the same remark applies as to wrought alloys—namely, that it is sufficient for the engineer to know the range of properties obtainable, and that before finally deciding on best grade of alloy and treatment he should discuss the subject with one well versed in the behavior of the different metals.

Three fundamental reasons limit the commercial range of casting alloys to a relatively small number, as against the larger variety that otherwise might be available: first, a desire to retain as simple an alloy as possible from the standpoint of composition control and scrap utilization; second, fabricating characteristics; and third, the question of the cost of the alloying elements, which restricts the commercial choice to a relatively small number of metals. In practice these are copper, silicon, zinc, manganese, magnesium, nickel and iron. Nearly all aluminum-base casting alloys are made up by the addition of one or more of these elements.

Fig. 2 charts the more commonly used casting alloys with respect to their average physical properties. Practically all of these alloys are available in ingot form for remelting (a few carry restrictions as regards patent rights). Many of them can be heat treated, yielding materials having ultimate tensile strengths approaching those of the wrought alloys. The available casting alloys have strengths ranging from 18,000 to 42,000 lb. per sq.in., with yield points ranging from 7,000 to 27,000 and Brinell hardness from 40 to 120. Usually the castings show an elongation less than that of a similar wrought alloy, the figure seldom going over 12 per cent in 2 in., and more often remaining under 5 per cent.

There are three different casting processes for aluminum alloys in use at present. The first is the familiar sand casting, in which the metal is poured into a mold made of sand; the second, the permanent-cold process, in which the metal is cast in a metal mold; and the third, the die-casting process, in which the alloy is forced into a steel mold under pressure. Each has its rather definite field of application and its specific advantages. Permanent-mold and die castings are used only where many identical parts are required, because of the high cost of the molds and dies. On the other hand, the metal molds produce a finished piece to very close tolerance and of good surface, which reduces the cost of finishing, machining and polishing.

Resistance to Corrosion

Freedom from attack of corroding agencies—chiefly the familiar rusting by the atmosphere or by water—is almost as important a quality of aluminum alloys as is the prime characteristic of lightness combined with strength. Pure aluminum is highest of the group in its

FIG. 4—ALUMINUM CHAIR
Approximately 20 linear feet of welding eliminates joints.

resistance to corrosion, but the high-strength alloys are only slightly inferior in this respect. Corrosion of the alloys, in fact, requires consideration only in very thin sheets, such as are used for frame members of airplanes and airships. In plates and shapes of the thickness used in the civil engineer's structural work, this corrosion—a peculiar surface effect called intercrystalline corrosion—has no importance.

Of the many interesting chemical properties of aluminum, this high resistance which it displays to the corrosion produced by atmospheric exposure is of greatest interest. The fact is that the metal is high up at the electro-positive end of the series of metals, and therefore ought to oxidize and corrode quite easily. This is indeed the case, for aluminum at once oxidizes in contact with air or moisture, but the oxide formed is a dense, continuous, adherent coating, which forms a protective film over the parent metal and promptly stops the corroding action, protecting the metal below as effectively as would an indestructible enamel.

FIG. 5—HOME WITH COMPLETE ALUMINUM ROOF
Shingles, flashings, downspouts, etc., utilize aluminum. Aluminum shingles weigh only 50 lb. per square (100 sq.ft.).

Aluminum and Its Strong Alloys in Industry

A survey of some important present-day applications of aluminum and its alloys will help to place these metals more definitely in respect to the art of today and its coming development.

To begin with the engineer's transit and similar precision instruments, it may be interesting to mention that instrument makers were among the first users of aluminum, even though the metal was expensive in those early days and almost nothing was known about the possibilities of its alloys. For instrument use there was decided advantage in a light-weight metal that was stable, uniform in composition and able to withstand exposure and hard service. Light weight could be obtained without making the instrument less rugged. Service experience has shown that aluminum transits are stronger and more durable, and have increased stability against vibration over those made of other metals.

In manufacturing work of this kind, the several fabricating processes and the various types of alloy and treatment permit of adapting the material to the special requirements of every part. In die-cast portions special bearing-metal inserts may be placed in the mold and cast integrally with the member containing the bearing—an unusually effective way of combining a part with its contained bearing. By similar process minor assemblies may be combined into single units, which gives greater accuracy and insures permanence of adjustment in service, especially as aluminum alloys do not "grow" or distort with age.

The non-tarnishing quality of aluminum has led to its substitution for silver in finely graduated circles and verniers, because burnished aluminum does not blacken when exposed to sulphurous fumes such as are encountered in the atmosphere of mining and industrial districts. Again, resistance to salt water is a distinct advantage, as was brought to view most strikingly in the case of a transit which was recovered in good condition after lying submerged for nearly three months in brackish water.

Transportation Uses—Transportation has made some of the most progressive applications of aluminum, in such widely different examples as buses, trucks, railway coaches and airplanes. The controlling incentive here is reduction of dead weight and therefore increase of pay load.

Railway and street-car frames, main girders, trucks and side panels have been made of aluminum alloys in considerable numbers. While it is obvious that substitution of a new metal in these parts is a truly revolutionary change, which can go ahead only very slowly in view of the necessary conservatism of the railway industry, yet every year sees an increasing amount of aluminum being used for these purposes. The pioneers in this work are the Pennsylvania Railroad, the Illinois Central, the Cleveland street railway system, the Chicago & Joliet Electric Railway, the Chicago & Northwestern Railway and the Springfield Street Railway Company, in addition to the Pullman Company, the General Electric Company and several others.

FIG. 6—ORNAMENTAL SPANDREL 54x60 IN.
Thickness of plane portions, ¼ in. weight, 115 lb. For a Cleveland high school; George M. Hopkinson, architect.

The Alton & Southern has gone even farther, and has made successful use of forged aluminum alloy connecting rods and crosshead assembly parts on locomotives. This installation effected a weight reduction per locomotive of more than 1,000 lb., representing 30 per cent of the weight of similar steel parts, and is reported to have reduced the rail hammer on the main driver by 98 per cent and on the other driving axles by 57 per cent. The meaning of such reductions on maintenance cost of both engine and roadbed is obvious.

Truck bodies have applied aluminum alloys in ways that are equally interesting to builder and user. Lighter bodies mean less power consumption, higher average speed and (primarily in the field of heavy hauling) increase in carrying capacity without exceeding the legal load limit. A study of the operation of five different companies using aluminum truck bodies in heavy hauling shows that an average aluminum body, costing about

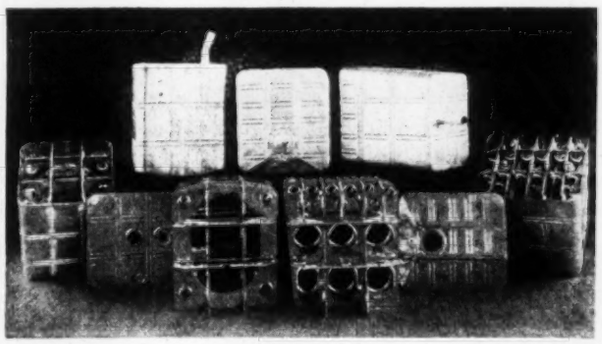


FIG. 7—AIRPLANE GASOLINE TANKS
With customary baffles to prevent surge and for added strength.

$600 more than a steel body, yields an increased revenue of $800 per year of service. Thus the lighter body writes off its extra cost in nine months and pays a clear $66 per month thereafter until its time of service is over, when it brings something like $300 to the owner as scrap.

In Aircraft—Lightness is essential in aircraft construction, but strength and durability are equally necessary. In such vital parts of the ship as the motor, wings and propeller, aluminum alloys play an important part. Cast aluminum crank cases, water jackets, cylinder heads and nosepieces are in common use, while one large manufacturer of radial airplane motors is employing forged crankcases and nosepieces.

Forged aluminum propellers are standard equipment on many of the finer planes. Because aluminum has a higher modulus of elasticity than the materials used in the older type blades, the torsional vibrations are reduced. An aluminum blade is much stronger and better fitted to withstand the punishment inflicted by rain and hail storms. However, the chief advantage of an aluminum blade lies in the fact that it will not break or splinter when it strikes an obstruction. The ductility of the metal is sufficient to allow many badly distorted blades to be straightened where otherwise the propeller would be a total loss.

Strong aluminum alloy tubing, sheet and formed or pressed shapes suitable for carrying heavy loads and yet giving a light structure are used very extensively in wing construction. A 60-in.-chord Clark Y-section wing rib for a navy fighter, stamped from "Alclad" aluminum alloy sheet ("Alclad" means coated by an integrally rolled facing of pure aluminum, as a safeguard against intergranular corrosion), weighs 0.453 lb. and will carry a uniformly distributed load of 850 lb. This wing rib supports 1,875 times its own weight! A Curtiss-Robin wing rib of similar material weighs 0.57 lb. and will support a uniformly distributed load of 540 lb. Certain aluminum alloy tubular wing spars have a load factor of 12. Aluminum alloy wing covering may be corrugated for strength; or, if a skin is all that is desired, flat sheet is used.

Machines and Chairs—Of more recent development is the adoption of aluminum alloys, both wrought and cast, by machine designers and manufacturers, mainly in moving parts, where lower inertia means less power, lower operating costs and often less vibration.

One of the newest structural applications of aluminum is in the production of chairs for offices, restaurants, theaters and libraries. Such chairs have been made either grain finished to an almost perfect reproduction of wood, or painted with colored enamels, and leather upholstered, and in this form are found in modern offices, in railroad dining cars and the like. The world's most prominent figure in aviation has a "flying office" in his cabin plane, fitted with aluminum furniture. It may be added that this chair manufacture offers a striking example of production welding; the welded frame joints form the parts into a continuous piece of metal, and the product is almost indestructible under ordinary use.

In Building Construction—Roofing sheets and shingles of aluminum, as well as corrugated sheet, sheet-metal fittings and nails have long been in use. But a more recent field that has opened to aluminum in connection with building is interesting—namely, the use of cast aluminum spandrels as part of the wall surface of high buildings. On the new Koppers Building in Pittsburgh more than 100,000 lb. of cast spandrels was used. This application utilizes to equal advantage light weight, freedom from corrosion and adaptability of the material to ornamental use. These spandrels are free from the danger of drip that might color the wall masonry below, as may happen with similar plates of corrodible metals, and they need no paint protection. The new 68-story Chrysler Building in New York similarly will be equipped with aluminum spandrels and copings, and will have windowsills of the same material throughout.

What has been done with aluminum alloys in building construction heretofore may prove to be of quite subordinate importance compared with the use of the material in major structural parts. Tests have shown that riveted or welded structural members built up of plates and angles can give strength and stiffness superior to those of structural steel parts at a decided saving of weight and with elimination of the risk of corrosion and cost of maintenance. The approaching commercial availability of large-sized structural material, to be described in the following article, will place these possibilities in the hands of structural engineers generally.

Gas From Cornstalks for Farm Use

A plan for the conversion into gaseous fuel of cornstalks, making possible the lighting and heating of farm homes, was presented in a paper read before a recent meeting of the American Chemical Society by A. M. Buswell and C. S. Boruff, of the University of Illinois. The suggested procedure involves the collection of the stalks in a closed fermentation tank into which are led the household wastes. The latter provides the necessary nitrogenous materials for the bacteria conducting the fermentation of the cornstalks, with the result that a gaseous mixture of carbon dioxide and methane, or marsh gas, is obtained, equal in heat content to ordinary gas. It is stated that enough gas to supply the needs of a family of four or five can be obtained from a tank 8 ft. in diameter and 8 ft. deep, as about 50 per cent of the weight of the cornstalks be converted into gas. The authors of the paper estimate that the usual gas supply for a city of 80,000 can be obtained from a circle of farm land 8 miles in diameter. After the gas has been obtained, the fibrous residue in the tank can be used in the manufacture of paper.

Atchafalaya Floodway for Mississippi Flood Control

Backwater Curves Utilized to Fix Capacity Grades of Floodway Levees—Values of *n* Taken at 0.175—Freeboard Changed to 4 Ft.—Contracts Aggregate 16,000,000 Yd.

By W. W. De Berard
Associate Editor, Engineering News-Record

PROGRESSIVELY down the Mississippi River the flood-control engineers are confronted with the absolute necessity of taking care of part of the flow of superfloods by diversion to auxiliary channels. The 1927 flood had a recorded outflow of 2,350,000 sec.-ft. below the latitude of Old River, where the Angola gage is located. The Mississippi and Atchafalaya combined cannot handle this amount safely. Much less can they handle the 10 to 28 per cent larger flows—which the river experts have set as the fair measure of a prospective great flood. At Old River, therefore, where the channel of the Mississippi can accommodate only half of the anticipated superflood, a diversion must be provided. This is the function of the Atchafalaya floodway.

The Situation

Before man confined the river by levees, the Mississippi flowed to the Gulf through a series of basins which flooded from 6 to 12 ft. in every high-water season. The basins are at the mouths of the principal tributaries. That one which surrounds the mouth of the Red River and its complicated discharging facilities at Old River is the largest and most important. North of Old River and Red River it is called the Tensas Basin and south of them the Atchafalaya Basin. The two basins are separated by the east-and-west watercourses of Old River and Bayou des Glaises, and by an east-and-west levee below Old River east of the Atchafalaya and below Bayou des Glaises west of the Atchafalaya. These features are shown by Fig. 2.

The line of levee is in effect a low earth dam which in even moderate floods forms a detention reservoir into which discharge the Red, Black and upper Mississippi rivers and from which through two outlets the pooled water discharges into the lower Mississippi and the Atchafalaya. This pooling has a wonderfully beneficial effect in eliminating sharp flood crests up to El. 57.5 on the Angola gage, which is the limit of capacity of the lower Mississippi as it is assumed in the adopted flood-control plan. Stages above 57.5 endanger the levees on the outlet rivers and particularly the levees forming the long low east-to-west dam at the head of the Atchafalaya. The alternatives for relief, then, are to increase all levee heights or to increase the capacity of the outlets.

The Plan Adopted

The plan as developed is as follows: The Mississippi at capacity being up to the top of its levees, these levees are to be raised 3½ ft. Also, the Atchafalaya is to have its levees strengthened and their irregularities corrected, to carry 500,000 sec.-ft. Additional flow is then to be provided by spilling surplus water into the Atchafalaya basin at its head through weak relief levees east and west of the river channel and by carrying the flow in two wide overbank floodways paralleling the river (Fig. 2).

Double meter readings at Angola and elsewhere indicated a discharge in 1927 of 2,336,000 sec.-ft. at the latitude of Old River. The Mississippi River Commission in its estimates and plans used 2,650,000 sec.-ft. with 3-ft. freeboard; the Chief of Engineers in the adopted plan uses 3,000,000 sec.-ft. with 1-ft. freeboard. (Recently this freeboard has been increased at certain places.)

With 1,500,000 sec.-ft. going down the Mississippi and 500,000 sec.-ft. down the Atchafalaya River, the floodways have to take the remaining 1,000,000 sec.-ft. When the outer floodway levee on the west side had been located and gave this floodway an approximate width of 7 miles (this had been done by the Spillway Board, which had been working on the project since early in 1926, and also fitted in with locations worked out by local interests), the problem was narrowed to backwater-curve computations to discover how much water the west channel would carry. That figure being found, the problem was to provide sufficient width on the east side for the remainder of the overflow.

Both the Spillway Board and the M. R. C. proposed entry to the west floodway by breaching the levees at the head of the Bayou des Glaises and also along the west bank of the Atchafalaya River. The adopted plan leaves the levees at the head as they are and strengthens the river levees to pass 500,000 sec.-ft. with approximately 3-ft. freeboard.

Several checks have been made of the discharge capacities of the west floodway under different assumptions of the getaway provided at the lower end. The final location of levees below Henderson has not yet been decided upon, and as most of these levees are marked to be constructed when "economically justified," some time may elapse before they are thrown up. In the following analysis, made by the hydraulic engineers of the New Orleans River District, definite locations are used in the lower stretches merely to define the calculations.

Backwater Curve Studies

Below the lower end of the Atchafalaya River levees, a 1,500,000-sec.-ft. discharge must be cared for to the Gulf. Some allowance should be made for storage, but this is small; the total is reduced only 50,000 sec.-ft. A trial backwater computation from Atchafalaya Bay at Gulf level to Morgan City, considering both channel and riverbank flow, gave an elevation of 12.0 at Morgan City. In the assumptions the width at Morgan City was taken as 13 miles and the lower end was assumed open. Figuring back to Six Mile Lake, peak stages were found to be at El. 15. Up to Morgan City the value of *n* in Kutter's formula was taken as 0.025 for channel and 0.150 for overbank flow.

The barrier structure of most consequence in this region is the Southern Pacific Railroad embankment, ranging from El. 7 to 10 between Patterson and Berwick and

from El. 10.9 to 12.7 between Morgan City and Bayou Boeuf. If it is raised above the superflood height, the existing inadequate openings would undoubtedly be enlarged to pass as much water as can be carried overland without creating appreciable head on the upstream side of the embankment.

Starting at the head of the lower Atchafalaya River with El. 15, the first stretch, covering Grand Lake, was divided into five reaches. Five or six cross-sections were available for each reach. For the lake flow n was taken at 0.0275 and for the overbank flow at 0.175. Above Grand Lake cross-sections were taken at 5-mile intervals on inch-to-the-mile maps on which contours were drawn from the available elevations. While 2-ft. contours could not be drawn, the higher ground seems well determined except for possible islands within swamp areas. More refinement would be desirable, but the section areas are held to be sufficiently accurate considering the uncertainty of the other factors, notably the value of n.

C. E. Ramser, senior drainage engineer, U. S. Department of Agriculture, in the St. Francis basin researches, found $n = 0.150$ the highest figure for overbank flow. For the Atchafalaya basin somewhat greater resistance and friction are assumed. The Ramser results were reported in *Engineering News-Record* Oct. 12, 1922, p. 598, and April 5, 1928, p. 540, and apparently are the only information available at present. The engineers of the New Orleans River District, however, during the flood of 1929 had a large number of observations and current meter readings made in the river flowing overbank across points. It is hoped to check on the value of n in a large number of cases to refine the present extrapolations that have had to be made.

BACKWATER CURVE ELEVATIONS, VALUES OF n, VELOCITIES FOR THE WEST FLOODWAY OF ATCHAFALAYA BASIN*

Section No.	Surface El.†	Width, Ft.	Ave. Mean Depth, Ft.	n	Velocity, Ft. Per Sec.	Ave. Area, Sq. Ft.
9	29.5	36,500				
Channel		800	64.3	0.040	7.31	56,560
Overbank		37,850	18.2	0.175	1.00	686,950
	Above 8 All Overbank Flow					
	33.0	39,200	17.9	0.175	0.86	695,930
7	35.6	38,200	16.1	0.175	0.85	702,230
6	38.6	49,000	14.9	0.175	0.71	841,350
5	41.0	65,000	12.9	0.175	0.71	844,300
4	44.2	65,000	12.9	0.175	0.86	702,150
3	49.1	45,400	15.7	0.175	0.94	638,500
2	53.4	37,000	15.6	0.175	1.02	588,160
1	58.3	38,400				

*Discharge is 1,100,000 sec.-ft. for 9-8 section and 600,000 sec.-ft. for remainder.
†Elevations are mean Gulf level.

Returning to the consideration of the backwater calculations in the bayou portion of the floodway above Grand Lake, it was found quite impossible to divide the flow between channel and overbank. It was therefore all computed as overbank flow, with the friction factors varied in each reach according to the watercourses and their apparent effectiveness. Reach 15 to 14, as shown on Fig. 1, had deep passes and much lake; here n was taken at 0.100, resulting in a velocity of 0.825 ft. per second. The next reach (14-13) had large channels and n was taken at 0.120, giving a velocity of 0.81 ft. per second. Smaller channel in reach 13-12 led to the use of $n = 0.130$, with resulting velocity 0.95 ft. per second.

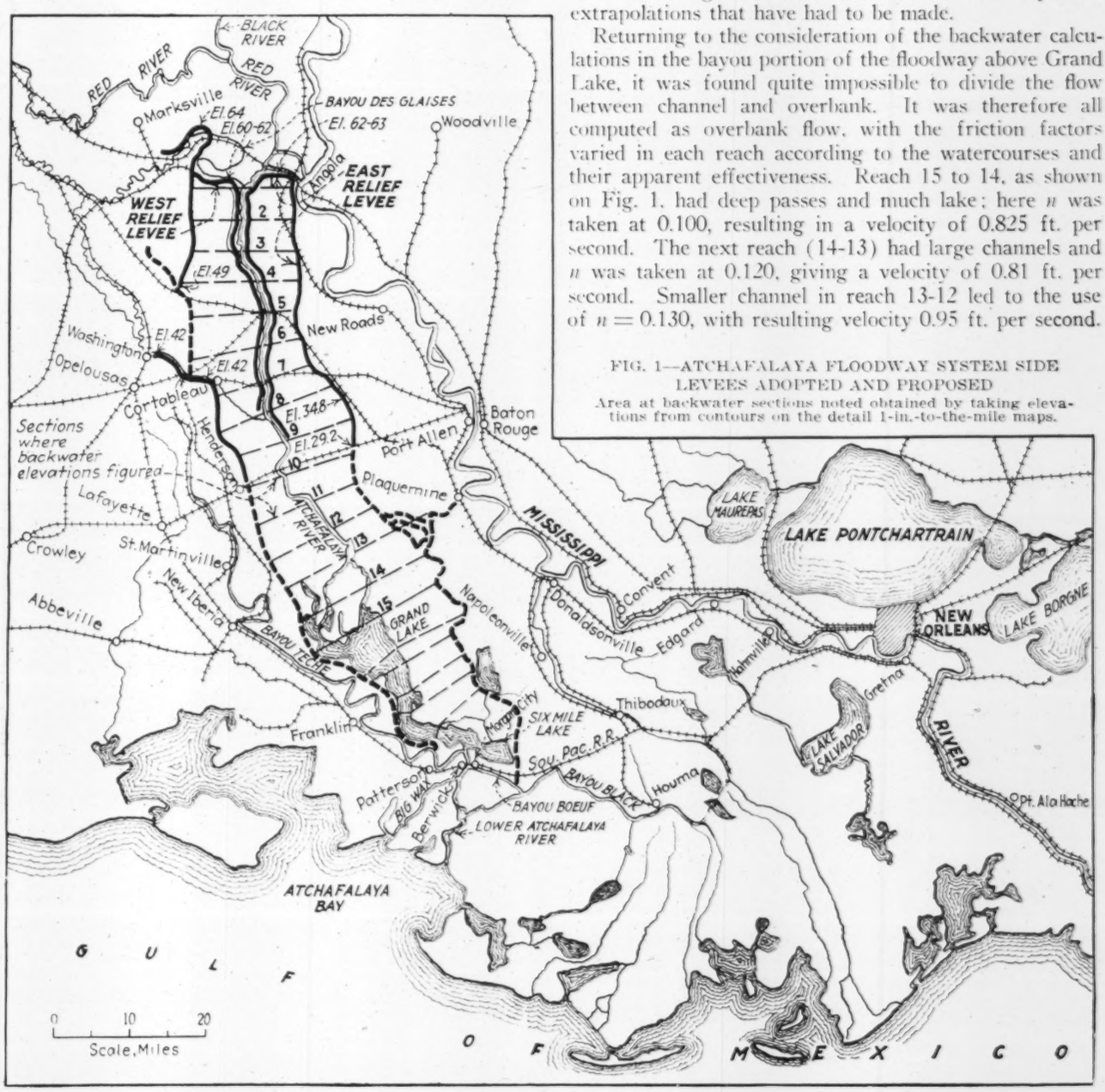


FIG. 1—ATCHAFALAYA FLOODWAY SYSTEM SIDE LEVEES ADOPTED AND PROPOSED

Area at backwater sections noted obtained by taking elevations from contours on the detail 1-in.-to-the-mile maps.

In the next two reaches, having fewer large channels, n was taken at 0.140, giving velocities of 0.98 and 0.87 ft. per second respectively. Reach 10-9 is plain river and overbank and n was taken at 0.040 and at 0.175, giving velocities of 0.83 and 5.20 ft. per second respectively. This split the volume of flow into 1,260,000 sec.-ft. overbank and 194,000 sec.-ft. river. The accompanying table gives elements of the backwater curve from section 9 up the right-bank floodway to the head of the basin.

River and Relief Levees

For the Atchafalaya River the elevations of the peak during the 1927 flood were considered to furnish the best possible data and to prove that 500,000 sec.-ft. can be carried between the levees. But these are to be strengthened greatly so as to make certain that the existing freeboard of 3 ft. above the 1927 peak is assured. Their integrity is essential, as a crevasse would discharge into one of the dry floodways or endanger the guide levees of an active floodway.

Levee grades for the floodways were first fixed at 1 ft. above the elevations given by the backwater curves, but for the levees to be contracted for in 1929 the crest grades have been increased 3 ft., giving a freeboard of 4 ft. A flow of 700,000 sec.-ft. in the right floodway with $n = 0.175$ will raise the flow about 1 ft. Should n prove to be 0.150 instead of 0.175, the 600,000 sec.-ft. discharge would have an additional foot of freeboard.

The average superflood elevation above the west bank relief levee entry will be 62.0. Usually the east floodway relief levees will experience higher flood elevations than those of the west floodway. The water surface at section 1, about 1½ miles downstream in the floodway, will be 58.3 for 600,000 sec.-ft. discharge with n at 0.175. Backwater computation in this 1½-mile reach brings the surface to 61.3 on the lower side of the relief levee. Raising the floodway levees higher, it is pointed out, cannot increase the maximum discharge, since this is fixed by width of spillway, pool elevation and friction factor.

Since the west relief levee is ½ to 1 ft. lower than the east relief levee and is of smaller section (8 ft. crown and 3 to 1 slopes), it will come into action first. After it breaks and after the floodway capacity of 600,000 sec.-ft. is exceeded and additional head is built up in the pool, the east levee will be overtopped. When the 400,000 sec.-ft. capacity of the east floodway is reached, the 1927 flood will have been exceeded by 28 per cent.

In case the higher levee of the east floodway break:

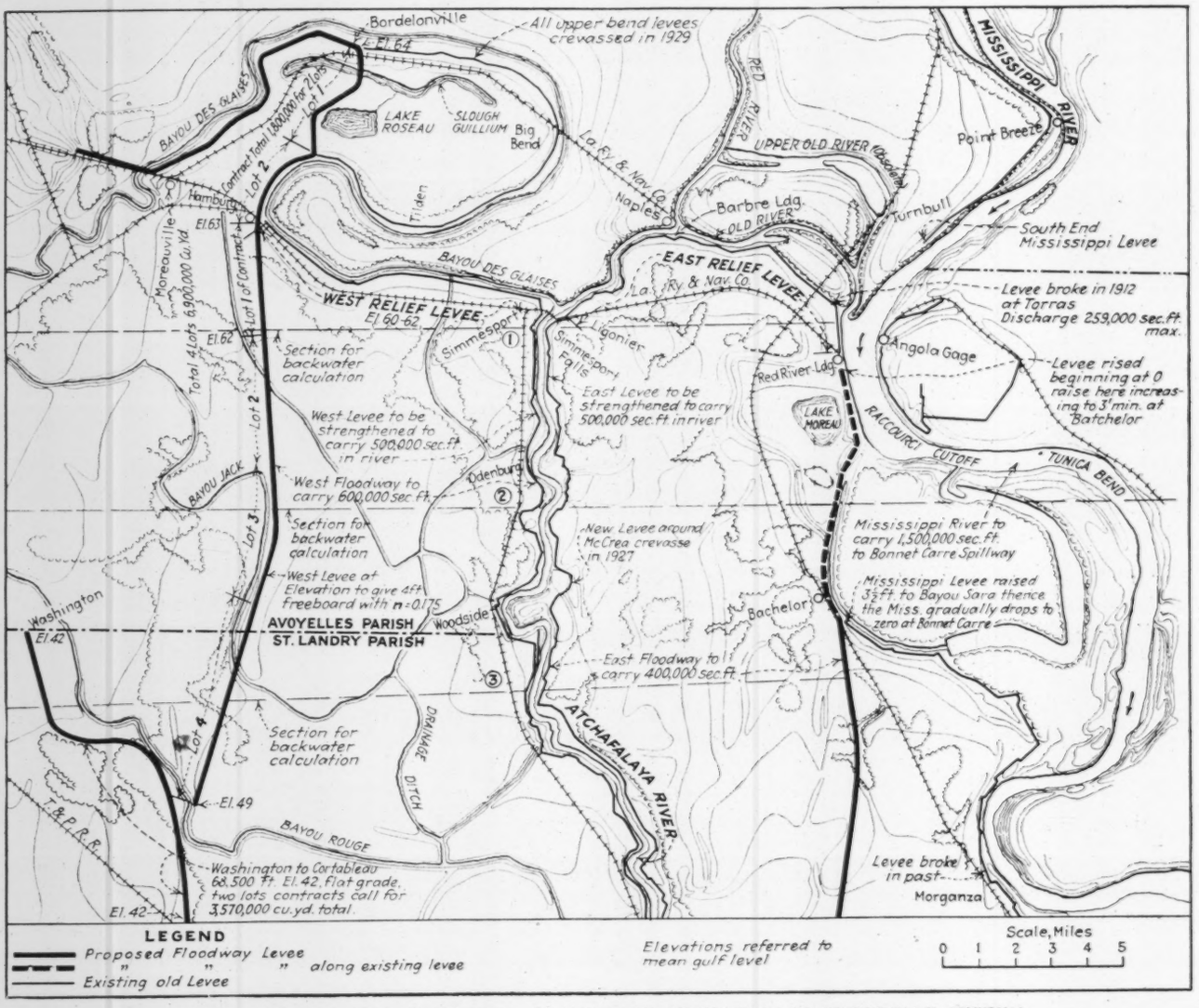


FIG. 2—THE RELIEF LEVEE AREA AT HEAD OF ATCHAFALAYA FLOODWAY SYSTEM

This contour map is one of four on a scale of 1 in. to the mile which was used to take off backwater curve sections at 5-mile intervals. A reconnoissance survey of the whole floodway indicates 10 per cent of the land cultivated. Only such timber as was finally located is shown on these maps.

first (from another cause than overtopping, such as a sand boil), it is believed that not to exceed 250,000 sec.-ft. would issue before the head on the pool will have risen and will have breached the west relief levee. The Angola gage changes more rapidly than any other on the lower river, which will bring action with smaller variations in discharge.

The effect of full floodway operation will be to overflow the lower portion of the Tensas over a maximum area of 1,700 square miles. In the lower Atchafalaya basin only 1,700 of the 4,200 square miles flooded in 1927 will go under water. Should the flood be such as to utilize only the west floodway, only 1,550 square miles will be flooded.

Much anxiety is felt by some engineers and river men over the condition of the two mattress sills at the head of the Atchafalaya. When placed (1888-1890), they were believed, and by many are still believed, to be a large factor in keeping the Atchafalaya from greatly increasing its flow and thereby its channel. This doubtless is true to some extent at low stages, but at high stages the sills can hardly be considered as having any more restrictive influence than the contractions of a Venturi meter. The 1927 flood caused a general subsidence in the upper sill averaging 9.1 ft. (with a maximum of 44 ft.) for a width of 560 ft. (Fig. 3). The lower sill was totally destroyed on the right bank above El. 24, mean Gulf level. The original sills consisted of mattresses.

Likewise apprehension is expressed of the deterioration of the Mississippi below Old River, but the engineers point out that the bar found at that point is of no more significance in high water than hundreds of other bars upstream and downstream therefrom. It is held that it has no more effect in high water than the Simmesport sills, which is considered nothing. In consequence neither of these points is believed to be a factor, at least for many years to come, in the flood-control problem. When it comes to navigation at low water, that is another matter, which may be serious.

Aside from strengthening and raising levees on the Mississippi and Atchafalaya, bids for about 16,000,000 cu.yd. for new floodway levees were received in July. The sections are divided into portions of approximately 1,500,000 to 2,000,000 cu.yd., but certain adjacent portions are arranged for two- and three-year continuing contracts.

The new floodway levees are mostly at the upper end of the right bank floodway. The first is from Bordelonville on the upper or north side of the Bayou des Glaises loop and runs west for 8 miles to high ground. The second portion is from Bordelonville south 6 miles to Hamburg, where it joins the west end of the weak relief section. These two sections are of the adopted strong-section type and are carried up at least 3 ft. higher than the 1927 peak. From Hamburg south for 20 miles along Bayou Jack to Bayou Rouge is the upper end of the east bank floodway levee. Its grade is to be 4 ft. above that indicated by the backwater computation. The last section is from Washington to Cortableau, 13 miles along the south side of Bayou Boeuf to connect at the latter point with an existing levee leading south to Henderson. This Washington-Cortableau section of new levee is all at one grade since it is on the lower side of a backwater pool.

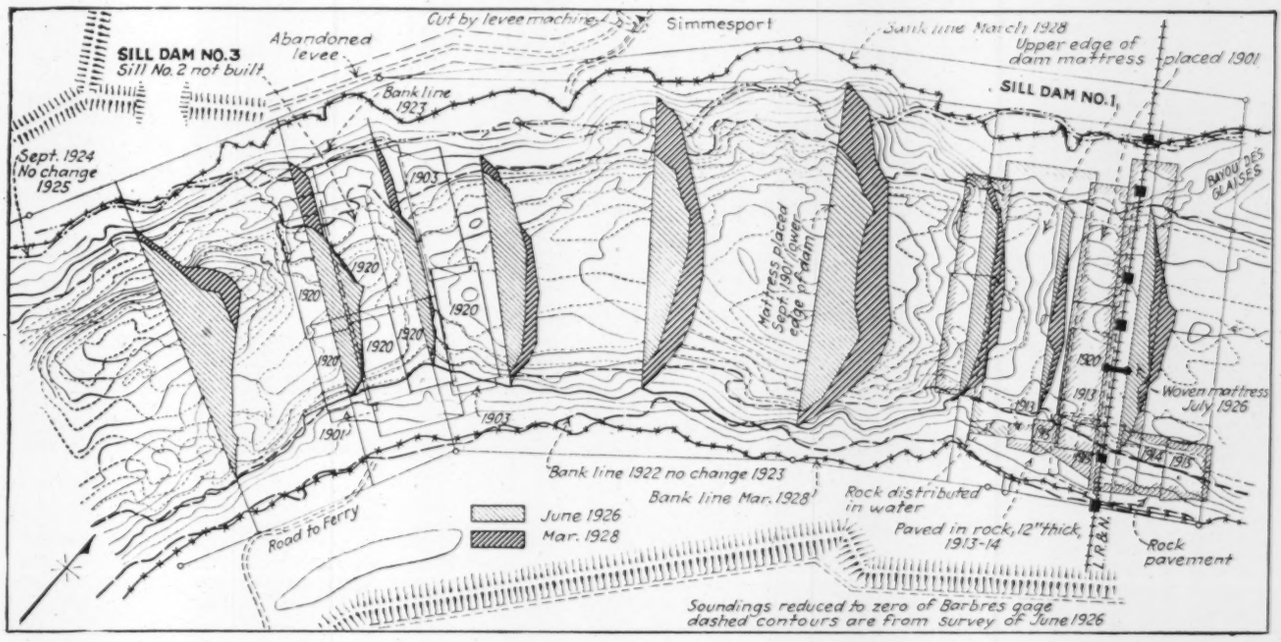


FIG. 3—ATCHAFALAYA SILL DAMS AT SIMMESPORT

Condition of sills indicates that repairs are needed to maintain their effectiveness, which is of value only in low water.

The above alignment cuts off the Big Bend loop made by the Bayou des Glaises Settlement of damage to this land is well under way but not concluded. Right-of-way suits for much of the right-of-way for the levees have been filed. Where agreements have been arrived at the price in most cases is said to be reasonably close to going value. Certain pieces will need to be condemned, but government contracts are often executed with levee contractors with that proviso.

Work for the government in the Atchafalaya basin is under the general supervision of W. H. Holcombe, Major, Corps of Engineers, U. S. army, district engineer in charge of the New Orleans River District. The civilian engineers are Roger B. McWhorter, senior engineer in charge of hydraulic calculations and design, and Harry Pokras, associate engineer in charge of the Atchafalaya area office, having charge of surveys and construction in the field.

Gas-Main Accidents in Europe Due Chiefly to Cold

Extreme Temperature and Condition of Old Mains Cause Many Breaks—Long Lines Suffer Heavily

By Carl Hanns Pollog
Köln, Prussia

ALL central Europe witnessed a wave of accidents resulting from gas-main leakings and breaks last winter. The number of these accidents has never been officially recorded in the various states, but if the minor occurrences of this kind are counted also, it may well run up to perhaps 500, while the number of casualties may safely be estimated at between 100 and 200. Consequently it is not to be wondered at that these accidents and their probable causes have been much discussed in the daily papers and the trade journals. A short summary of the developments may be of interest.

Much has been said and written especially about the causes of this strange series of accidents. There is scarcely a large town which has not witnessed one or more events of this kind since last autumn and the total number has been greater during a few months than even for decades before. It cannot be said that the causes have been established beyond doubt, but the most probable explanation will be found in the following:

The gas works in all large towns of the Continent were built and gas mains laid at about the same time. The old material is worn out now, especially as few repairs were made during the war and during the post-war time on account of the bad financial situation. The automobile traffic also has increased very much during recent years, especially in Germany and the other central European countries. This of course must have its underground effects, especially as there are still a large number of heavy motor lorries running on solid rubber tires and, in some countries, even on iron tires.

Cold Winter Is Blamed

Moreover, the past winter in central Europe was an unusually cold one, which in most regions brought the lowest temperatures on record since meteorological observations have been made. In consequence of this the soil was frozen to 5 to 7 ft. and more. Thus the gas mains were exposed to lower temperatures than had been calculated for in their construction and this often directly caused breaks by the contraction of the pipes. Also the solidly frozen underground transferred the vibrations caused by the traffic to greater depths than it would do under ordinary circumstances. Surely it cannot be by chance that the curve of the number of accidents was at its highest point during the last third of January and during the month of February, which exactly coincides with the period of the severest frost.

The frozen soil often seems to have been more impervious to the gas escaping from fissures in the mains than the ground walls of the houses; therefore a large number of casualties and necessary temporary evacuations of houses was brought about because gas from broken mains in the street diffused into the houses of the neighborhood. In one town of central Germany several persons were found asphyxiated in a house that had no gas connections at all—an accident which caused much comment. The heavy frost often made the determination of the exact location and repair of the breaks very difficult, as the soil had to be broken with pneumatic hammers. Many of the minor accidents of this kind which involved no loss of life and little or no damage to property but only gave rise to much anxiety in the neighborhood never got into the papers, but their number may be guessed from the fact that, for example, in Köln fifteen of them occurred during a single day in the second half of February.

In some instances—for example, in London, Berlin and Prague—explosions of escaping gas blasted open the streets for hundreds of yards. The flames spurting from the soil generally could be quenched only some time after the gas mains of the whole district had been shut off. These accidents attracted much public attention, though in fact they did not cause as much damage to life or health as the gas creeping noiselessly into the houses from below.

Sometimes explosions which occurred in the sewerage systems were caused by gas having found its way there from leaking mains. But in certain other instances later investigations showed that there had developed petrol or acetylene vapors. How this had been possible could not be said with certainty, but it seemed to have resulted from careless handling of waste waters of industrial works, garages, etc. As in the case of the gas explosions, these accidents generally caused damage to the streets, but sometimes had a touch of the comic, too. For example, when such an explosion occurred in the small town of Westerburg, in the Westerwald mountains, a heavy shaft cover of the sewerage system was hurled up to the height of the second story together with an ox-cart and two oxen which had been standing on the cover.

Accidents on Long-Distance Systems

A special chapter in this story might be devoted to the accidents in the long-distance gas-supply systems. The exhaust gases of the high furnaces and coke ovens of the Ruhr basin are more and more being utilized for cooking and heating purposes, sometimes being conducted over considerable distances to the large towns. It was along one of these long-distance gas mains that several of the first serious gas accidents in Germany occurred in rapid succession. The pipes are run partly overground in open country, but mostly, and especially in inhabited areas, underground, and as they had been laid only one or two years ago, the material could not yet have been worn out. Moreover, the breaks occurred invariably at the welded joints of the pipes. Therefore the company which had laid the mains was charged with having worked without the necessary care. It seems, moreover, that in planning the long-distance gas-main system enough attention had not been paid to avoiding areas where settlings of the subsoil were likely to take place on account of the mining operations carried on below. Also it has been said that it would have been better to select another and more elastic method of connecting the single pipes instead of welding them. The company, however, published a report in defense of its methods, stating that only nine out of more than 4,000 welded joints had given trouble, which in a single case had been caused by a defect in the material used. These accidents gave occasion to vivid discussions in the town councils of several places which were about to be connected to the long-distance gas supply, but I could not trace a record of any contract of this kind not having been signed or being canceled on account of them.

British Rainfall, Water Consumption and Water Treatment

Notes on the Recent Drought, With Summaries of Per Capita Water Consumption, Methods of Water Purification in Use and Sheffield's Unique Treatment Plant for Providing Compensation Water

By M. N. Baker
Associate Editor, Engineering News-Record

COMPARED with much of the area of the United States, England has a low rainfall and short streams with small drainage areas. But its per capita water consumption is low. As bearing somewhat upon the recent low rainfall and water shortage in England, noted briefly immediately below, a table is given showing rainfall and runoff in the Thames drainage area, one of the chief sources of London's water supply. Summaries of water consumption and kinds of water treatment in the United Kingdom follow. Even those familiar with British practice may be surprised by these figures, which, so far as I know, are more comprehensive than any published heretofore. The concluding notes of this article on treating polluted water at Sheffield and pumping it up the river valley in lieu of letting pure water downstream to meet claims of riparian owners deal with a practice that appears to be without parallel. The recent drought brought the purification and pumping plant into use after some years' shutdown.

The recent drought and water shortage throughout the northeastern United States follows a similar experience in England, noted a few weeks ago in our news section. In the opening part of the accompanying article the drought in England is again taken up, together with some other phases of British water supply. The present article, like the one on large water pipe in our issue of Sept. 12, is based on observations made by Mr. Baker on his recent trip to England. ***—Editor.***

When I arrived in London early in July the daily newspapers were headlining the current drought and water shortage. Inquiries in various quarters led me to conclude that with a few notable exceptions serious shortage of water was a future rather than a present menace, depending on whether the abnormally low rainfall during the first half of 1929 proved to be the introduction to a series of dry years. It was chiefly the stored supplies that were causing worry, since, with some minor exceptions, groundwater sources had not yet been badly affected. The following notes on a few interviews will suffice for present purposes:

Herbert Lapworth, a London consulting engineer dealing almost exclusively with public water supplies, told me that British practice is to provide storage up to the drainage area yield of the three driest years that have been experienced within the past 50 years. These were 1887-89. There was a drier three-year period about 1800. Should the 1887-89 record be repeated, many cities would be seriously short of water, but the principal cities would pull through; however, if the earlier low record were duplicated, many places would be "in a bad way." Up to the close of last December, he said, the rainfall was about normal, but for the first half of 1929 it had been subnormal, in some places down to half.

A large pile of unopened letters relating to the water shortage was awaiting the attention of E. A. Sandford-Fawcett, chief engineering inspector of the Ministry of Health, when I called upon him in the huge building in Whitehall which houses that important branch of the British government. To make stored supplies last longer, four of Mr. Fawcett's inspectors were then at the North conferring with riparian owners to obtain temporary release for cities from "compensation water" requirements, which under British practice frequently make it necessary to turn downstream 50 to 60 per cent as much water as is diverted for municipal use. The unusually heavy freezing of the ground last winter, Mr. Fawcett said, decreased the yield to the storage reservoirs. Twice in the first half of July the Ministry of Health sent out precautionary notices to conserve water.

Unexpected delay in completing a new conduit, rather than the drought, caused the Metropolitan Water Board to forbid the use of water through hose for garden sprinkling and for washing motor vehicles early in July, 1929, said C. F. Marsh, deputy chief engineer. The conduit, when ready for use, will make available some 24 Imperial, or nearly 30 U. S., million gallons daily. The ban on using hose for motor-vehicle washing was removed early in August, but not that on sprinkling. Meanwhile, there had been considerable rain, but while this was enough to help vegetation, it seemed unlikely to augment stored water supplies materially. Mr. Marsh expressed the belief that there would be a dry period of two or three years in Great Britain.

Rainfall at Salisbury, near the southern coast of England, I was informed by Charles Notley, deputy city engineer, was only 6.49 in. in the first seven months of 1929, against 15.37 for the same period in 1928. The water supply being drawn from the chalk, the shortage had not yet been felt.

The total yearly average rainfall at twelve stations in the Thames Valley above tidewater at Teddington Weir ranged from 19.92 in. in the seasonal year 1921-22 to 43.61 in. in 1903-4. The average for the past 26 years was 30.79 in. For the year 1928-29 the twelve stations showed an average of 25.91 in. The seasonal year begins with March. The winter meteorological quarter includes December, January and February. This quarter for 1928-29 had an average rainfall of 4.84 in. for the twelve stations, which was the lowest in 21 years, or since 1908-9, when the winter quarter showed 3.99; in 1904-5 the corresponding figure was 4.09. The rainfall from March to July, 1929, continued low, but specific figures are not available. By three-year periods, the

years 1919-20, '20-'21 and '21-'22 are the lowest, with an average rainfall of 22.61 in.; while the highest was 31.07 in. for the last three years ended with February, 1929, or the last three of the 26 years under consideration.

Those who wish to study the seasonal rainfall for these twelve stations for the 26 years and to compare it with the corresponding daily average flow of the Thames above Teddington Weir may consult the accompanying table, from which the figures just cited have been either taken directly or computed.

Per Capita Water Consumption in the United Kingdom

Water London, with a population of 7,000,000, uses only 37 Imperial, or about 42 U. S., gallons of water per capita per day. This is a fairly representative figure for British cities, as will appear from data to follow. So low a figure is all the more remarkable when it is noted that domestic consumers are rarely metered in England. Three explanations for this low figure, compared with the much higher average of American cities, are: less leakage from street mains, house services and fixtures; less waste; and a lower standard of living. (The latter was stressed in an article on American and European water consumption by Abel Wolman, *Engineering News-Record*, June 13, 1929, p. 943.) This does not mean a lower standard of cleanliness, personal or household, but rather a lower standard of convenience, although the latter may react unfavorably on the former.

In my recent visit to England I was impressed anew with the few fixtures available for drawing water, both in houses and at many hotels. Water has to be carried to rooms in pitchers. This means not only a lessening of actual use but also of waste, as in letting water run from a faucet until it becomes hot. Moreover, summer temperatures average lower than in America, so there is less water run to the sewers to get cooler water. Winter temperatures average higher than ours, so little water is wasted to maintain motion and prevent freezing in house pipes. Add to all this the greater official care in getting and keeping house connections tight, less extensive gardens and lawns and fewer motor cars to be washed and one can readily understand the relatively low water consumption—a condition that prevails throughout the whole United Kingdom. It should be added that in rural districts which have public water supplies, as well as in towns of considerable size, there may be no water available inside many of the houses, or at most only one faucet. In some villages I noticed water faucets in niches on the street side of the garden walls so common in England. A view of one of these is here reproduced.

On my voyage to England I tabulated by quantity classes the per capita water consumption of 633 cities of the United Kingdom, as given in the "Water Engineer's Pocket Book and Directory, 1929," grouping those under 10 Imperial, or 12 U. S., gallons per capita, of which I found 121, and on up in steps of 10 Imperial gallons. Of places with a consumption of 80 Imperial, or 100 U. S., gallons per capita or over there were but five out of 633 and going down to 70 Imperial, or 85 U. S., gallons added but three more, making eight in all.

The number of places in each consumption group for each of the four countries is shown by the accompanying table, as also which group and which three groups include the largest number of places, or may be said to dominate. Averages for all the places listed for each component and for the whole United Kingdom could not be computed for lack of population data. A fair substitute is the combination of the three dominating groups, given in the small sub-table. For the United Kingdom the 10 to 39 Imperial, or 12 to 47 U. S., gallon group dominates, with 507 of the 633 places, or 80 per cent, included. By separate counties, the ranking percentages are: England, 90; Wales, 84; Ireland, 80; Scotland, 71.

Turning to single consumption groups, 20 to 29 Imperial, or 24 to 34.4 U. S., gallons per capita dominates, not only for the United Kingdom but also for England and for Wales, the percentages being 37, 43 and 54 respectively. For Ireland, the 30-39 Imperial, or 36-47 U. S., gallon group is in the lead, with 36 per cent of all places included. The dominating group in Scotland is a step higher, 40-49 Imperial, or 48-60 U. S., gallons, with 31 per cent of the places included.

In only a few cases was domestic and trade consumption reported separately in the annual from which the foregoing figures were compiled. While in Salisbury, a city of 30,000 in southern England, I was told by Charles Notley, deputy city engineer, that the average daily water

RAINFALL AND RUNOFF OF RIVER THAMES FOR THE 26 SEASONAL YEARS 1903-4 TO 1928-9 INCLUSIVE

Daily averages by meteorological quarters and yearly totals. The quarters are: spring, March to May; summer, June to August; autumn, September to November; winter, December to February. The rainfall is based on the total mean at twelve stations above tidewater at Teddington Weir, and the runoff is from the river basin above that point. The table has been photo-reproduced from the annual report for 1928 of Sir Alexander Houston, director of water examinations, Metropolitan Water Board, and is there credited as having been "Computed from Thames Conservancy Board Returns." The board last mentioned, Sir Alexander states, has "custody of the Thames from Teddington to Crickdale" and controls pollution "over an area of 3,656 square miles," which appears to be the entire drainage area above Teddington Weir.—M. N. B.

Year.	Daily Average Natural Flow (million gallons.)					Total Rainfall (inches.)				
	Spring.	Summer.	Autumn.	Winter.	Daily average for Year.	Spring.	Summer.	Autumn.	Winter.	Total for Year
Cols. 1	2	3	4	5	6	7	8	9	10	11
1903–4	1952·3	2001·4	2641·0	4310·0	**2722·1**	9·48	13·01	12·02	9·10	**43·61**
1904–5	1727·2	654·0	448·0	670·7	**877·3**	5·63	5·95	4·73	4·09	**20·40**
1905–6	1179·1	454·5	507·9	2087·1	**1053·0**	6·75	8·46	6·83	7·75	**29·79**
1906–7	1075·4	365·4	784·9	145·0	**916·4**	3·99	4·66	10·02	4·92	**23·59**
1907–8	1075·4	525·7	960·4	2672·0	**1305·6**	6·64	7·25	8·79	6·96	**29·64**
1908–9	2288·7	775·2	612·0	968·0	**1163·5**	8·66	7·42	4·79	3·99	**24·86**
1909–10	1126·8	702·5	1229·5	3030·6	**1514·9**	7·27	9·57	8·92	9·82	**35·58**
1910–11	1591·9	841·0	917·8	3108·4	**1553·7**	5·21	8·43	7·82	8·15	**29·61**
1911–12	1468·6	474·1	562·6	3573·0	**1516·6**	5·40	3·35	8·19	13·11	**30·05**
1912–13	2319·4	1013·0	1615·3	3482·8	**2101·5**	6·09	12·55	7·64	9·00	**35·28**
1913–14	2394·6	773·8	836·1	1327·5	**1279·6**	8·73	3·26	9·62	5·52	**27·13**
1914–15	2007·3	588·7	526·9	4975·5	**2012·5**	7·05	6·86	7·09	16·03	**37·03**
1915–16	2032·5	863·9	1136·5	3771·1	**1948·3**	5·48	7·91	7·81	12·39	**33·59**
1916–17	3697·9	927·5	1668·1	2704·2	**2248·6**	7·83	7·78	10·57	6·08	**32·26**
1917–18	1755·4	1109·8	1730·8	2123·7	**1677·4**	6·34	12·39	7·36	5·98	**32·07**
1918–19	1658·1	781·3	1261·2	3374·2	**1761·3**	6·53	6·88	10·25	10·11	**33·77**
1919–20	3129·4	989·1	770·3	2262·3	**1789·2**	8·06	6·22	4·84	8·94	**28·06**
1920–21	2070·2	1093·6	872·4	2062·8	**1523·6**	8·18	8·87	5·83	5·77	**28·65**
1921–22	685·1	253·0	302·1	820·3	**514·0**	4·03	2·49	5·24	8·16	**19·92**
1922–23	1558·2	610·8	593·8	2307·1	**1263·6**	6·74	9·73	4·65	10·11	**31·23**
1923–24	2249·6	591·3	1028·7	2560·7	**1606·6**	7·08	5·00	9·82	6·81	**28·71**
1924–25	1541·0	1575·9	2168·2	4356·6	**2400·4**	9·37	9·78	11·00	10·91	**41·06**
1925–26	2075·6	743·6	1491·1	3590·5	**1967·7**	5·99	7·09	8·83	9·09	**31·00**
1926–27	1648·0	801·0	1188·3	2183·8	**1452·0**	6·43	6·39	9·59	7·19	**29·60**
1927–28	2563·0	907·0	2362·9	4920·7	**2683·2**	5·97	10·58	10·96	10·19	**37·70**
1928–29	2145·9	751·9	930·7	1705·8	**1383·0**	5·22	7·01	8·84	4·84	**25·91**
Ave.	*1886*	*815*	*1121*	*2638*	Ave.	*6.70*	*7.65*	*8.17*	*8.27*	**30.79**

* *These averages have been added to the original table.—M. N. B.*

CLASSIFICATION OF PER CAPITA WATER CONSUMPTION IN THE UNITED KINGDOM

(Compiled from the Water Engineer's Pocket Book and Directory, 1929)

	England	Wales	Scotland	Ireland	Total
Under 10	10	1		1	12
10– 19	113	6	2	5	126
20– 29	199	23	4	9	235
30– 39	110	9	13	14	146
40– 49	16	4	28	8	56
50– 59	9	...	19	2	30
60– 69	2	...	18	...	20
70– 79	...	...	3	...	3
80– 89	1	...	2	...	3
90– 99	...	...	1	...	1
Over 100	...	...	1	...	1
	460	43	91	39	633

Dominating Group

	Rate	Works	Per Cent
England	20–29	119	43
Wales	20–29	23	54
Scotland	40–49	28	31
Ireland	30–29	14	36

Combination of Three Highest Groups

	Group	Works	Per Cent
England	10–39	422	90
Wales	10–39	36	84
Scotland	40–69	65	71
Ireland	20–49	31	80
All four	10–39	507	80

consumption for the quarter year ended June 30 totaled 47.57 U. S. gallons per capita. Of this, 16.43 was metered to industrial consumers; 0.38 was for street watering, based on cartloads used; 4.82 gal. was allotted to sewer flushing and miscellaneous uses. These three items total 21.63 gal., leaving 25.94 U. S. gallons as the domestic per capita rate.

Water Treatment in England, Wales, Scotland and Ireland

It was in London, in 1828, that what is generally believed to be the first slow sand filtration plant was built for the Chelsea Water Company, with James Simpson as engineer, but there is a tradition that the projected filters were to be like those of Glasgow. This reminds me of a passage which I found quite unexpectedly in reading a book prior to review: "A better proof of his [Watt's] unimpaired mental powers occurred in 1811 when the Glasgow Waterworks Company consulted him with regard to carrying water from the *filtering area* [italics mine] to the pumping engines on the south side of the Clyde." (From "James Watt and the Steam Engine," by H. W. Dickinson and Rhys Jenkins. Oxford, England: Clarendon Press. New York: American Branch, Oxford University Press. 1927. $21.) While giving the Scots credit for pioneering in sanitation mention may be made of the application of Edinburgh sewage to the Craigentinny Meadows for over 200 years.

How rapidly filtration was adopted in England it would be difficult if not impossible to tell at this late day, but in or about the 1850's an act of Parliament ordered all the surface water supplied by the various London water companies, or perhaps that from the Thames only, to be filtered.

Nor is it possible to give the exact nature and extent of water treatment in England and other parts of the United Kingdom today. Common understanding, supported by the figures given later on, is that most surface supplies are filtered; certainly when liable to material pollution. Slow sand filtration is the chief reliance, with prefiltration by mechanical filters in a number of cases, and many mechanical plants standing alone. Chlorination is advancing, but conservatism holds it in check. Softening, iron removal and treatment to prevent attacks of active water on pipe are all practiced.

As might be expected, the London Metropolitan Water Board leads all other water authorities in the United Kingdom in water treatment, in total capacity of its works, the skill with which they have been adapted to a variety of local conditions and the care and skill with which they are operated.

Like many other Americans interested in water treatment I was cordially received by Sir Alexander Houston, director of water examinations, Metropolitan Water Board, during my visit to England. His annual report for the year 1929 was just out. As is the case with its predecessors, it is no dry-as-dust document. Besides giving in sufficient detail current operating data, supplemented by summaries easily understood by the general reader and of strong appeal to water experts as well, the report continues Sir Alexander's personally conducted tours over the London water-works, covering points of technical, scenic and literary interest. Scores of handsomely reproduced halftones are presented, accompanied by entertaining text. Like most other government publications in England, this report is for sale (21 shillings from P. S. King & Son, 2 Great Smith St., Westminster, England). A few leading points regarding the treatment of London water follow:

Of the average daily supply of 260 Imperial, or 312 U. S., million gallons supplied to 7,000,000 people, 58 per cent is taken from the Thames, 25 per cent from the Lee and 17 per cent from deep wells. All is pumped once and most of it twice. Practically all the water is stored, one of the main elements in the improvement of the water, Sir Alexander has long maintained. All the river water is filtered, some of it twice, through 176 acres of filter beds. Besides storage and filtration, from 70 to 89 Imperial, or 84 to 118 U. S., million gallons daily of the raw Thames water is chlorinated, except during high floods, when the river is not utilized. Chlorine is also applied to 30 to 40 Imperial, or 36 to 48 U. S., million gallons daily of River Lee water at least three months in the year. Effluent from the large filter plant at Walton is also chlorinated.

The Walton filtration plant, in use for some two or three years, treats Thames water after storage. The water first passes through primary filters (no coagulation) working at the average rate of 112 Imperial, or 134 U. S., gallons per square foot per hour, or 130 U. S. million gallons per acre per day. It then goes through secondary (slow sand) filters at the rate of 5.6 Imperial, or 6.73 U. S., gallons per foot per hour, which is 5.85 U. S. gallons per acre. Finally the water is chlorinated, the average dose being 0.2207 part per million. Average bacterial results at the various stages (agar at 37 deg. C.) in 1 c.c. of water were as follows: Raw water, 275;

WATER TREATMENT IN THE UNITED KINGDOM

		Some Kind of Filtration						Other Kinds of Treatment					
		Sand	Slow Sand	Filtered	Mech. Filters	Total Filters	Chlorination	Softening	Lime	Hardening	Acid	Aeration	
England	492	47	28	24	63	162	24	24	4	6	2	2	
Wales	51	4	3		3	10	2			2			
Scotland	98	22	12	1	23	48	1						
Ireland	41	10	4	3	4	21	1						
	642	83	47	28	93	241	28	24	4	8	2	2	

SUMMARY OF FILTRATION AND CHLORINATION BY COUNTRIES

	Total	Some Kind of Filtration	Per Cent	Chlorination
England	492	162	33	24
Wales	51	10	20	2
Scotland	98	48	50	1
Ireland	41	21	50	1
	642	241	38	28

stored water, 15; primary filters, 18 from one set and 21 from the other; secondary filters, 4.3; after double filtration and chlorination, 3.7. Although 91.6 per cent of the raw-water samples contained B. coli in 1 c.c. or less, after final treatment no B. coli were shown in 96.4 per cent of 100-c.c. samples.

Typhoid deaths in the administrative county of London (not co-extensive with but including a large part of the area and most of the population of Water London) were at the rate of 1 per 100,000 in 1928, where the rate has been, approximately, since 1921, with a fall to 0.7 in 1926 and 1927. The rate in 1900 was 17 per 100,000 and in 1901 and 1902 it was about 12, falling to 8 in 1903, which has not been equaled since. No figures for the war and post-war years 1915 to 1920 are available.

The relative extent to which the various methods of water treatment are used in the United Kingdom is shown by the accompanying table compiled from the "Water Engineer's Pocket Book and Directory, 1929." The data are not wholly satisfactory, because of indefiniteness in many of the reports submitted for publication in the annual, but presumably they indicate prevailing practice. Of 642 cases of treatment in the United Kingdom tabulated, 241, or nearly 40 per cent, are some kind of filtration, only 28 chlorination, 24 softening, 8 hardening, 4 lime and 2 acid treatment. Two report aeration. A few instances of iron removal were reported but not tabulated. Of the 241 reporting some kind of filtration, only 93, or about 40 per cent, specify mechanical filtration, but probably a few of the entries under "sand" and more of those under "filtered" belong under "mechanical." Pressure mechanical filters appear to be common. Because a number of places reported two kinds of filters, each of which was counted because there was nothing to show which kind was dominant, the total number of filtrations is too high. I made no attempt to show how many of the supplies chlorinated are also filtered.

By countries, as the small sub-table shows, Scotland and Ireland tie in having the largest percentage of filtration plants of some kind. England comes next, and Wales last—probably due to the character of the sources of most of the supplies in Wales. Nearly all the chlorination plants are in England.

Treatment of Highly Polluted Water for Compensation Purposes at Sheffield

So far as I can learn, Sheffield stands alone among the cities of the world in that it softens and filters water drawn from a river below its sewage-works outlet and forces it back upstream to a point below one of its water-works storage reservoirs, in lieu of providing "compensation water" to the riparian owners below the reservoir—a general practice in England, but almost unknown in the United States.

The water supply of Sheffield is from near-by storage reservoirs on four streams—a fifth stream is to be drawn upon. Right to divert 10 million Imperial gallons daily of water from the River Don was conditioned on providing an equal amount of compensation water. A dozen years or so ago the city authorities applied to Parliament for authority to substitute treated water for the potable stored water. This was granted, but the amount was restricted to half the volume—5 Imperial, or 6 U. S., million gallons daily—with some hope of a grant of the full amount if the plan gave satisfaction. The Parliamentary act set up the following standard for the treated substitute water, in parts per 100,000 as a maximum: Suspended matter, 2; hardness (as calcium carbonate), 8; oxygen absorbed (from permanganate of potash in four hours), 0.75.

PUBLIC WATER FAUCET IN AN ENGLISH VILLAGE

One reason why British water consumption is low. From a snapshot in Laverton, a small village in Worcestershire. Some of the houses have water "laid on." One in which the writer spent a week had a fully equipped bathroom, but hot and cold water was carried by maids to each bedroom.

The sewage department, under John Haworth, chemist and manager, operates the treatment plant for the water-works and, in accordance with British municipal interdepartmental practice, is paid for doing so.

Water is pumped from the River Don, below the sewage-works outlet, softened with lime and soda ash, and filtered, a little alum being used to reduce color. The water thus treated is pumped to an elevation of 350 ft. through 11 miles of 26-in. pipe and returned to the River Don just below the water-works storage reservoir. Until the 1929 dry spell this plant had not been used for four or five years, because the city had not needed water from this particular storage reservoir. Only as much water is treated and pumped as is being drawn from the reservoir.

River Don water is taken and treated instead of sewage-works effluent because of an understanding with an industrial plant on the river that sewage-works effluent will continue to be discharged into the river above its plant. It would be cheaper to use the sewage effluent than to treat the river water, and such an arrangement may yet be made. It should be understood that the treatment plan outlined was agreed on before the activated-sludge plant was built.

It may be noted that efforts are now being made, and in some cases have already been consummated, to reduce the percentage of compensation water to riparian owners established some time back and now regarded by many as excessive. This effort appears to have government support. Temporary alleviation was granted by some mill owners during the 1929 dry spell.

Train Wreck Test for Steel Sphere to Carry Helium

Spectacular Demonstration in Milwaukee Showing How Safely the Gas for Dirigibles Can Be Transported

METHODS of transporting helium in quantity from the gas fields of western Texas to the point of use by dirigibles at the various airports of the country are yet to be worked out in detail, but a test of a huge spherical vessel Sept. 10 by the A. O. Smith Corporation, Milwaukee, indicates at least one solution of the problem.

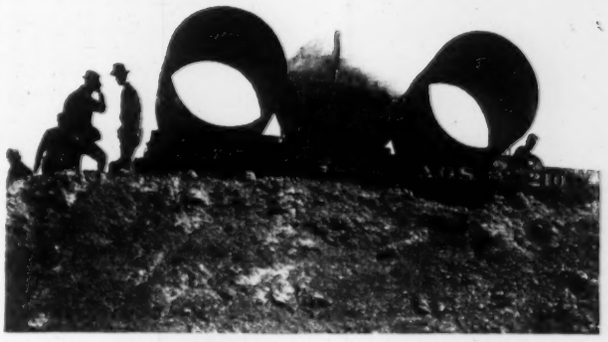
Before testing to destruction, a 6-ft. steel sphere under 1,250-lb. air pressure was loaded on a flat car between two 7¼-ton steel cylinders and run over the end of a 25-ft. railroad fill. No damage was sustained or pressure lost.

While this test was spectacular and put on primarily for moving and talking pictures and as a demonstration for the tank car committee of the American Railway Association of the serviceability of such tanks, it was nowhere near so severe as the routine shop acceptance tests to which the builders had already submitted the great globe nor yet that to which it was later subjected in the field laboratory.

The vessel was made of two 1½-in. plates pressed into half-spheres and electrically welded along the equatorial line. Before loading on the flat car it was subjected to 1,250-lb. hydrostatic pressure and hammered for 72 hours with a 6-lb. sledge with blows equivalent in foot-pounds to the weight of a square foot of the metal shell. The blows were delivered by an air hammer and represented 20,000,000 impacts of a flat-car wheel over 38,000 miles of travel.

After the "wreck" there was repeated the routine shop acceptance test, which is as follows: A hydrostatic pressure of 1,200 lb. per sq.in. was first applied, this being the working pressure and representing a stress of 14,500 lb. in the metal. Then the pressure was lowered to 1,000 lb., again raised to 1,200 lb., then lowered a second time to 1,000 lb. and then raised a third time to 1,200 lb. and hammered on the weld. The pressure was then raised to 1,660 lb., representing a stress of 20,000 lb. in the metal. Thereafter a gradual rise in pressure to 2,500 lb. was made, which disclosed that the elastic limit had been reached between 2,200 and 2,500 lb. The pressure was then applied with the idea of bursting the vessel, but a small blowout at the attachment for the pressure gages occurred at 4,400 lb., and after holding this pressure for several minutes the pressure was released for repair. At this point measurement of the girth indicated a circumferential enlargement through the polar section of 17 in. Final application of the pressure then exploded the vessel at a pressure of 4,500 lb. Several of the ten pieces into which the shell was torn were in the shape of sections of an orange-peel bucket with no breaks parallel or along the weld. The minimum thickness to which the area near the poles farthest from the weld was stretched was 1.05 in.

The principal reason for the experimental work on the use of spheres rather than cylinders is that metal in this form is stressed half as much per square inch as in a cylinder for the same pressure, thus permitting higher pressures and greater total volumes to be transported per unit. It is planned to ship six spheres on a car holding a total of 200,000 cu.ft. of gas.



THE SPHERE UNDER 1,250-LB. PRESSURE LOADED BETWEEN TWO 7¼-TON CYLINDERS AT ONE END OF THE CAR

Note the circumferential weld made electrically along the edges of two hemispherical plates.

FLAT CAR CARRYING HELIUM VESSEL CATAPULTED FROM END OF 25-FT. EMBANKMENT

The 7¼-ton steel cylinders on either side of the sphere were held by straps in contact with it until they hit the ground, when they separated widely.

Doings of the New England Water Works Association

Papers and Reports on Water-Works as a Business Enterprise, Pumps, Aeration, Color Removal and Chlorination, Pipe, Meter and Flow Tests, Painting Standpipes

Engineering News-Record Staff Report

FIFTEEN papers and ten reports on a variety of subjects made up the technical program of the 48th annual convention of the New England Water Works Association held at Portland, Me., Sept. 17 to 20. As there were seven sessions and most of the committee reports were brief, there was ample time for discussion. The only congested session was the "Superintendents' Meeting" on Wednesday evening, but by carrying this on until well toward midnight every one had his say. The business and entertainment features of the convention are detailed in the current news section of this issue.

The papers dealt with some of the business aspects of water-works administration, with measures to protect and improve the quality of water supplies, with pumping plants, testing cast-iron pipe, field tests of large meters, flow and pressure surveys, and making water-works structures attractive. In addition there were several papers describing water-works systems.

Making Every Tub Stand on Its Own Bottom

Financial administration was taken up in the presidential address, in a committee report and in a paper by Ralph S. Bauer, mayor of Lynn, Mass. The thesis of Mayor Bauer's paper was that every water-works plant should be operated on a thoroughgoing business basis, paying all its capital, operating and maintenance charges out of revenue, the latter to include payment to the water department for all water supplied by it and all services rendered to other municipal departments. Cowardice and political expediency on the part of municipal governing bodies frequently result in the water department being operated quite differently from the ideal set up by Mayor Bauer.

At another point in the program the Massachusetts representative of the legislative committee of the association, George A. King, superintendent of water-works, Taunton, Mass., took up a subject closely related to that of Mayor Bauer's paper. Mr. King stated that the Massachusetts Legislature in 1928 passed an act providing that the disposition of all water-works revenue must be subjected to general municipal budgetary control, instead of being used as water departments see fit. This gives city councils a free hand in using water revenues for other than water-works purposes for the sake of keeping down the general tax rate. A bill designed to insure the restriction of the use of water-works revenues to water-works purposes failed of even getting out of committee for action by the Massachusetts Legislature of 1929.

The presidential address of Arthur D. Weston supported the thesis of Mayor Bauer as well as the underlying principle of the legislative bill just mentioned. Discussion from the floor led to the adoption by the convention of a resolution looking to a study of some of the points raised by the discussion, including the determination of the proper basis for general taxation to meet the cost of that part of the water-works burden arising not merely from supplying water to various municipal departments, but also from the greatly increased capital charges due to building water-works large enough to meet the heavy but generally quite brief and relatively infrequent demand for a large volume of water for fire-protection purposes.

Improving and Protecting the Quality of Water

Of five papers on the quality of water, one by Malcolm Pirnie, consulting engineer, of New York City, opened with a declaration that every year millions of dollars of water-works investment are unnecessarily destroyed by corrosion of pipe caused by active waters. Such waters are notably prevalent in New England. Aeration by fine spraying combined in some instances with the use of a small amount of lime or other chemicals would reduce the carbon dioxide which causes the mischief. Methods of such treatment and some operating results at Providence, R. I., West Palm Beach, Fla., and elsewhere were included in Mr. Pirnie's paper.

"Color Reduction in Storage Reservoirs" was the title of a paper by Caleb Mills Saville, manager and chief engineer of the Hartford water-works. Predictions made years ago by the late F. P. Stearns, called in by Hartford to advise on the need for stripping vegetable matter from a reservoir bottom, have been verified by experience. Mr. Stearns expressed the belief that in a dozen to fifteen years water from unstripped reservoirs would be of about the same color quality as it would have been had the reservoirs been stripped. Data in support of this assumption, based on experience, were submitted by Mr. Saville.

Satisfactory experience with automatic chlorination of the water supply of Concord, N. H., was outlined by Percy Sanders, superintendent of the water-works of that city. Although there are only some 75 inhabitants on the 4 square miles of catchment area from which the water supply is drawn, and although the city owns 98 per cent of the shore line, and although such boating and fishing as are permitted at points remote from the intake are controlled by license, the city decided to chlorinate the water. Apparatus for that purpose was put into operation in 1928. A vacuum type of chlorinator with Venturi meter control to meet a fluctuation from 500,000 to 6,250,000 gal. daily in water consumption was installed in a gate house, together with a heater for winter use. The apparatus is inspected four times a week. There has been some trouble with valve stickage. The apparatus is not in duplicate, but duplicate parts are provided. After the presentation of Mr. Sanders' paper President Weston stated that during the recent drought fifteen Massachusetts municipalities ran short of water and five had to draw on emergency sources, some of which were badly polluted. Chlorinating apparatus was rented for

temporary use. In one instance the pollution was so bad that the state Board of Health advised that the water be boiled.

Another paper relating to protection of quality of water had the very suggestive title, "Watching the Water in Safeguarding Public Water Supplies." The author was Arthur E. Gorman, sanitary engineer, Wallace & Tiernan Company, Newark, N. J. Among weather changes that may endanger public water supplies unless proper methods of safeguarding are taken is a sudden downpour of rain that may wash pollution into surface supplies. Heavy winds long continued may set up currents that will send polluting matter toward the water-works intake. A source of danger at Chicago is reversal of the flow of the Chicago River and Drainage Canal so that sewage will be discharged into Lake Michigan, the source of the city water supply, instead of into the Mississippi River system.

Under the "intriguing" title, "Enforcement With Other Beverages," J. Frederick Jackson, consulting engineer, Hartford, at one time engineer of the Connecticut State Board of Heath, reviewed attempts to control bathing in reservoirs and other sources of water supply in the state named. After drawing a parallel between some of the basic reasons for prohibition of the use of liquor and of bathing in public water supplies, and the difficulties of enforcement in each case, Mr. Jackson quoted a Connecticut statutory prohibition of bathing in public water supplies (Conn. Rev., 1918, Sec. 2544) as follows:

> Every person who shall bathe in any reservoir from which the inhabitants of any town, city or borough are supplied with water, or in any lake, pond or stream tributary to such reservoir, or who shall cast any filthy or impure substance into such reservoir, or any of its tributaries, or commit any nuisance in or about it or them, shall be fined not more than $100 or imprisoned not more than six months or both. Prosecutions under this section may be had in the town in which said city or borough is.

Attempts to enforce the statute have been few. The law does not place enforcement upon any agency. One lawsuit resulted in a court decision that the bathing in question was illegal but that it was not the function of trial court to go further. An appeal is pending. In concluding his paper, Mr. Jackson said in effect that it seems to be a question whether to retain a statute so broad that it defeats the purpose for which it was passed, but does give a certain measure of protection, or to substitute one in which limits of danger were defined and enforcement of which might be at least 50 per cent efficient.

To the defense of the statute in question came Warren J. Scott, director of the bureau of sanitary engineering, Connecticut Department of Health. Mr. Scott said the paper made no mention "of the vast number of Connecticut supplies where the law has been unquestionably obeyed." As to making the statute less stringent in the hope of better enforcement, Mr. Scott said that it would be difficult to decide where to draw the line.

Four Plants Described

There were four papers devoted to individual water-works. The first one, describing the system of the Portland Water District, was by James W. Graham, president and general manager. The history of the organization of the district was outlined by David E. Moulton, clerk and attorney of the district. As is the case with a number of other water districts in Maine, this one was created to take over the works of private water companies, most or all of which were supplying two or more municipalities. One reason for the formation of these districts was that the city and towns, acting as such, lacked legal authority to issue bonds. The Portland Water Company before its works were taken by the district paid dividends totaling $1,750,000 to stockholders whose cash payments for stock had been only $800. Some of the stock was given to a newspaper that had criticised the water company. Following the two papers on the water district, John C. Stevens, an architect, read a paper entitled "Beauty in Water-Works Structures," which was listened to with all the more interest because a few hours earlier those attending the convention had visited the water-works shop storage house and garage of the district, designed by Mr. Stevens. The building is of irregular shape, about 300 ft. in length altogether. The irregularity in shape and attention to architectural details, which are quite simple, combined with planting of shrubs around the structures, make the building attractive. Mr. Stevens said, in conclusion, that a real estate operator in Portland expressed the belief that the water-works building has increased the value of surrounding property by at least 50 per cent.

Of two other descriptive papers, one by H. G. Huy was on the new 20,000,000 gal. daily pumping and filtration plant of the West New York Water Company, of which Mr. Huy is general manager. The other described water-works improvements for Springfield, Mass., carried out over a period of years, the author being E. E. Lochridge, chief engineer of the Springfield water-works. A notable feature of work now in hand is the Cobble Mountain hydraulic-fill dam, described in *Engineering News-Record*, July 26, 1928, p. 124.

Pumps and Pipe and Other Testing

Diesel pumping engine plants were the subject of two papers. The first of these was by A. D. Couch, mechanical engineer, Community Water Service Company, New York City, who outlined studies made to determine whether to use steam, electricity or oil in diesel engines for power in a certain plant. A conclusion in favor of diesel engines has been substantiated by operating experiences. The author pointed out that had electric current been available at as low a price as it can be had in some places the diesel engine would not have been adopted. Diesel engine pumping units of less than 1,000,000 gal. daily capacity, put in for Wayland and Wilmington, Mass., were described in detail by J. Howard Hayes, of the Hayes Pump & Machinery Company, Boston, Mass.

Three kinds of testing were described in as many papers: Foundry tests of cast-iron pipe, by William R. Conard, of Conard & Busby, Burlington, N. J., who outlined the principal tests made by inspectors employed for that purpose by municipalities and water companies; tests of large meters in place, by R. E. Ferguson, assistant superintendent Hersey Manufacturing Company, Boston; and volume and pressure tests, by Herbert E. Smith, of the Simplex Valve & Meter Company, Philadelphia.

On the hydrostatic or pressure test of the smaller pipe Mr. Conard said:

> There was a time in pipe making when this test was applied in an adequate manner to all sizes, as it still is in the case of larger pipe. The present practice in testing 3- to 20-in. pipe, however, can be termed adequate only if the specified pressure applied for as short a time as ten seconds is considered satisfactory. The reason the pressure is held for such a short period of time is that provision of facilities for this part of the operation of producing pipe has in most cases been lost sight of in the endeavor to keep up to quantity production, and the necessary

room and apparatus for the testing have not been provided for by the manufacturer to the same extent as have the facilities for the other manufacturing operations. On the importance which the purchaser attaches to the hydraulic test would therefore depend the period of time to be specified that the pipes are to be held under pressure, before they are accepted.

In discussing Mr. Conard's paper, S. E. Taylor, superintendent of water-works, New Bedford, Mass., said he thought the pressure test should be applied for a longer period than is common in order to give a better chance of detecting porous pipe. E. E. Lochridge, of Springfield, Mass., and Mr. Graham, of Portland, Me., indorsed this opinion. H. A. Hoffer, of the United States Cast Iron Pipe & Foundry Company, admitted that the foundries do not have facilities for testing the smaller sizes, but pointed out that while a foundry may cast only four lengths of 72-in. or twelve lengths of 42-in. pipe in a day, on coming down to 6-in. pipe several hundred would be cast, making it impossible, under present conditions, to apply a pressure test for so long a period as for the larger pipe. Longer tests for smaller pipe and also improvements in the metal used for cast-iron pipe of all sizes could be had if the municipalities were sufficiently interested to be willing to foot the bill for the additional expense that would be incurred.

Painting Standpipes

Nearly all the committee reports submitted were brief reviews of "progress." Most of them related to pipe and fittings. To correlate the work of the committees on standard specifications a new committee has been formed, headed by C. W. Mowry, assistant manager, inspection department, Associated Mutual Factory Insurance Companies, Boston. The only long report submitted was on painting standpipes, by A. O. Doane, division engineer, Metropolitan District Commission, Boston, Mass. The gist of this report was that, all things considered, the best material for painting standpipes is red lead with a mixture of litharge for the interior. Mr. Doane expressed the hope that his committee would soon have its report ready for action by the association. In the ensuing discussion James W. Graham, general manager of the Portland Water District, expressed satisfaction with the "Main hot coating" that has been used on the standpipes of the Portland Water District. The privilege of the floor was given to M. B. Main, painting contractor, who summarized his experience in the application of "hot coating" to from 25 to 35 tanks and standpipes each year for many years.

Detroit Water Meeting Considers Filter Sand Troubles

WHAT is wrong with present-day design of filter washing equipment and its operation and one answer to the question were the principal topics of discussion at the combined meeting of the Central States Section of the American Water Works Association and the seventh Michigan Conference on Water Purification, held Sept. 16 to 20 at Detroit, Mich.

The Michigan conference met separately for one day. It took up several highly technical analytical problems encountered in operation, including experience with alum at Flint; advances in water softening, use of chlorine, bacterial media and the chemists' end of sewage disposal. The A.W.W.A. section, aside from water-filtration problems, took up meter reading, customer accounting, financing, service installation practice, state supervision of supplies, methods of laying pipe under railroad tracks and a description of the new filter plant at Saginaw, Mich.

For a whole day the joint sessions were given up to a discussion of the studies made in an experimental plant and the large 320 million gallon daily plant at Detroit on washing filters. The discussion was opened by a paper in two parts. Roberts Hulbert, senior chemist, in presenting the first half of the paper indicated that the Wolman and Powell article on shrinkage in *Engineering News-Record*, July 29, 1920, p. 210, had started the studies. He related experience with clean sand, sand cleaning and high wash rates, in which is was concluded that there is a critical rate of effective wash depending not on vertical rise but on sand expansion, which in turn is dependent on viscosity of the water and sand grain characteristics. Viscosity being dependent on temperature, winter washing at low rates is as effective as the much higher rates necessary for the same lifting and sand-scouring power in the high temperatures and thin viscosities of summer. Minimum expansions of 50 per cent, requiring upward of 40 in. vertical rise of wash water, keep beds clean, once they are clean. The effect on design and operation of doubling the wash-water rates claimed the earnest interest of many of the leading consultants of the country, who sent in a dozen or more written discussions. Pipe size, tank and pump capacity, economic size of filter unit and the whole underdrain system are all seriously affected. A ray of hope for the troubles of existing plants was indicated in the use of a filtering media of lower specific gravity, such as coal, as used at Steelton, Pa., Dallas, Tex., and Denver, Colo.

The second half of the paper, on the washing characteristics of filter sands, was presented by Frank W. Herring, assistant civil engineer. He described yardsticks by which sands may be evaluated as well as a formula for the rate of washing in terms of expansion, temperature and sand size. This checks fairly closely with one developed some time ago by Allen Hazen. Incidentally, notation of an economical method of cleaning the old sand beds of the Detroit system with lye and subsequent hosings under high pressure was of particular value to the operators.

W. C. Lawrence, superintendent of filtration, Cleveland, presented in discussion a detailed account of the troubles with dirty sand at the Baldwin plant of that city, which went bad the second summer. By increasing the washing rate with the rise in temperature Mr. Lawrence has succeeded in eliminating the piling up and cracking of dirty sand around the edges of the filters, increasing runs by 36 per cent and saving 16 per cent of wash water. His maximum rate was 39 in. vertical rise required for a temperature of 72 deg. F. and a minimum of 24 in. for a 32 deg. temperature. He works on the basis of 50 per cent sand expansion.

Armco Makes Safety Record

At midnight Aug. 8 the East Works plant of the Middletown division of the American Rolling Mill Company had completed 1,158,000 man-hours without a lost-time accident. This is 45 consecutive days for more than 3,700 men. This is thought to be a world's record for a steel plant and supplants the record ended June 29 made by the Butler Works of the Columbia division of Armco. The Pennsylvania plant completed 66 consecutive days but only 1,006,135 man-hours.

From Job and Office

Hints That Cut Cost and Time for the Contractor and Engineer

Long Gage Length Device Increases Accuracy of Strain Readings

By D. P. Thayer
Assistant Bridge Engineer, Salem, Ore.

IN ORDER to increase the accuracy of strain gage measurements, the device described herein was suggested by the writer and was subsequently used by the engineers of the Oregon State Highway Commission during the final erection of the Smith Ferry bridge in Douglas County, Ore. A photograph of the device as applied to a top chord member is shown in Fig. 1. A

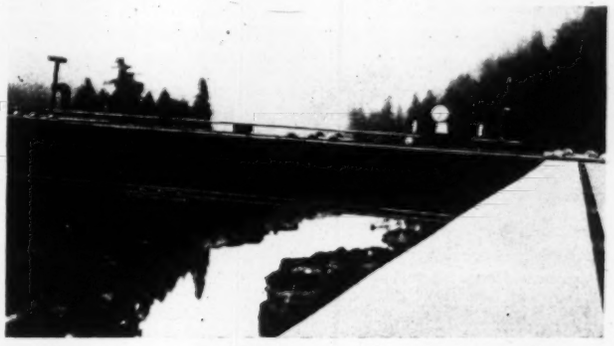


FIG. 1—STRAIN GAGE SET-UP TO SECURE LONG GAGE LENGTH

very close agreement was found between theoretical stresses and those calculated with the aid of the readings from this strain gage set-up.

One end of a 5-ft. piece of a 2x¼-in. steel bar was clamped to the member with a triangular block of steel between to secure a knife-edge bearing on one end. The other end of the steel bar was supported on a short piece of 1-in. diameter shafting acting as a roller. At a point 60 in. from the knife edge a small rectangular steel block 1¼ in. thick was clamped, thus bringing the top of the block and the top of the bar to the same level. One gage point was placed on the block and one in the bar, as shown. The readings due to actual deformations in the members were thus made 7½ times what they would be if the usual 8-in. gage lengths were used. Errors due to inaccuracies in drilling the gage holes, dirt on the gage points, slight movement of the gage, etc., remain constant, and hence the percentage of error is much reduced. The set-up is especially advantageous where low stresses are to be measured.

It is also planned to apply this device to concrete

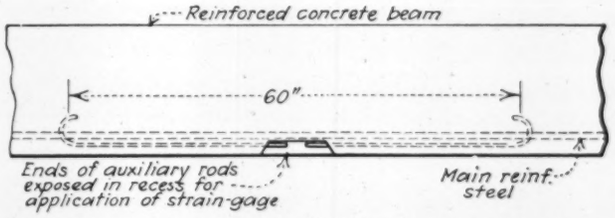


FIG. 2—LONG GAGE LENGTH SET-UP FOR STRAIN MEASUREMENTS IN CONCRETE BEAM

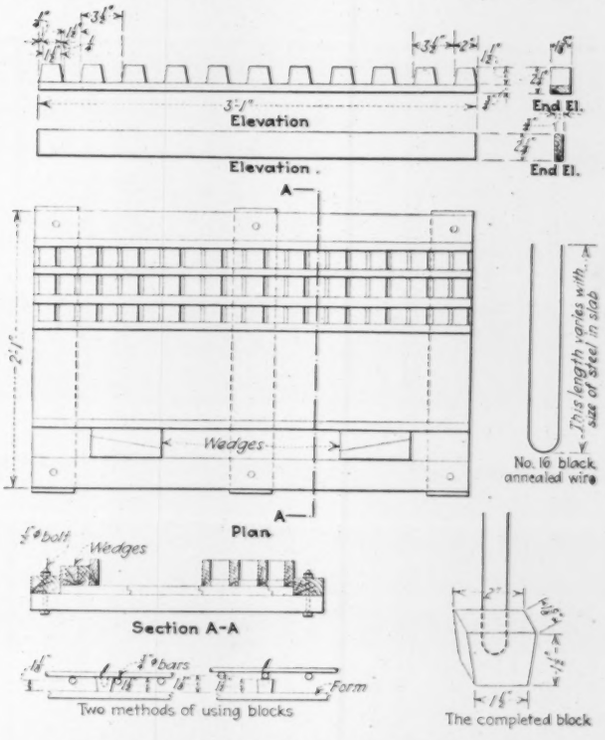
structures as shown by Fig. 2. Two ⅝-in. plain round bars in cardboard sleeves will be embedded in the concrete in the plane with the reinforcing steel. The hooks at the ends will be solidly anchored in the concrete and enough of the abutting ends of the bars will be exposed to permit the application of the strain gage.

Collapsible Form Facilitates Making of Blocks to Support Reinforcing

By Walter S. Todd
Bridge Designer, Frankfort, Ky.

A CONVENIENT form for making concrete blocks for supporting reinforcing steel in slabs of bridges or buildings is shown in the accompanying drawing. The form consists of a wooden frame or platform upon which are placed the separate sawtooth wooden forms alternating with the slats, which are made of ¾-in. lumber. These several parts are clamped in place by means of the wooden wedges.

Mortar, made of screened sand and cement of the



DETAILS OF FORMS FOR SUPPORT BLOCKS

same proportions as that of the sand and cement in the concrete of the structure, is placed in the form and pressed into each mold to insure perfectly molded blocks.

Black annealed wire (No. 16) may be bent as shown and placed in the forms in a manner similar to that employed by a gardener in planting onion sets. The mortar should be pressed down with the thumbs after the wire is put in place to insure that the blocks will

be solid and be not easily broken. The length of wire will depend upon the size of reinforcing steel to be supported. By the use of the wire the blocks may be held in position even if the reinforcement is shifted.

The concrete blocks may be quickly removed when the mortar has set, by removing the wedges and turning each sawtooth form upside down. A tap on the form will make all blocks fall out. Before using, the form should be cleaned and painted with some old cylinder or paraffin oil to prevent blocks from sticking. The form shown will make 70 blocks and can be filled in about half an hour. A form of this kind was used by the writer on bridge construction, and after three or four years' use was still serviceable.

Calculating Length Limits for Shipping Pieces Longer Than One Car

By Henson K. Stephenson

Structural Designer, Chesapeake & Ohio Railway Company, Richmond, Va.

THE problem of finding the maximum length of pieces that can be shipped over a given railroad route is common to steel-fabricating plants and railway traffic departments. When the shipping length of a piece is too long for one car, the ends of the loaded car are removed and the piece is extended through into an idler car in front or rear or both, depending on the length of the piece. There are, however, limits of length for such shipping pieces, and four variable factors enter

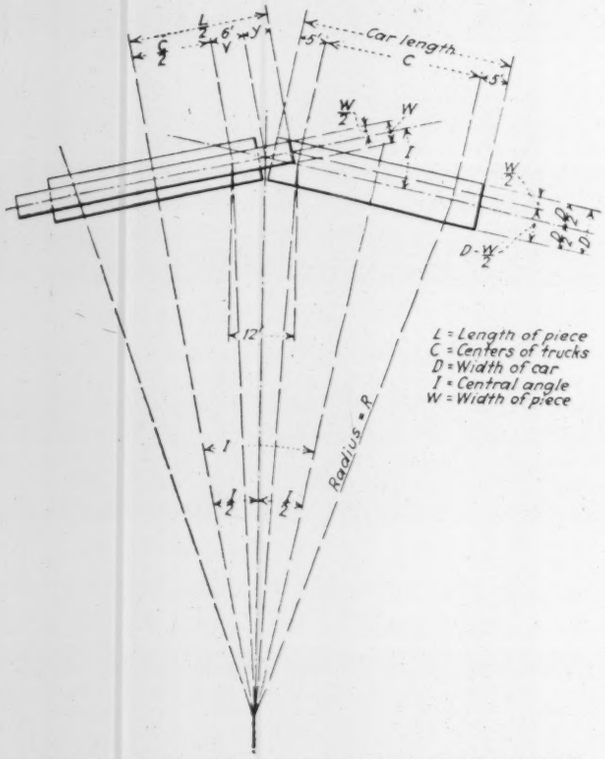


FIG. 1—FACTORS INVOLVED IN CALCULATING MAXIMUM LENGTH OF SHIPPING PIECES

into their calculation. Referring to Fig. 1, these factors are: (1) C, center to center spacing of trucks; (2) D, width of car; (3) R, radius of maximum curve; and (4) W, width of piece or pieces.

To work out each given problem involving these four variables requires considerable time, and to save this time, the chart, Fig. 2, has been prepared. In order to simplify the problem, the chart has been designed using two cars of the same length.

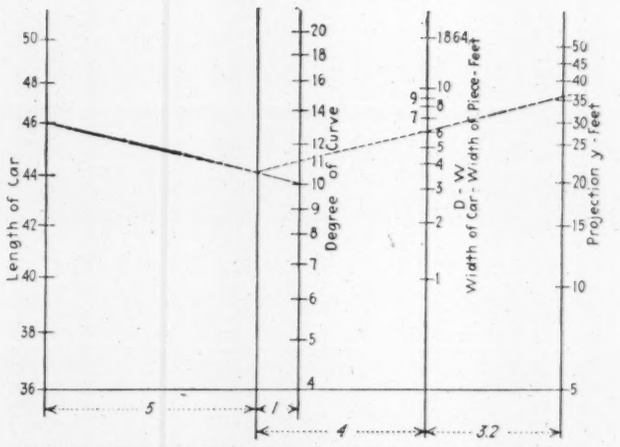


FIG. 2—NOMOGRAPH FOR CALCULATING MAXIMUM LENGTH OF SHIPPING PIECES

Referring to Fig. 1, the angle I may be found for any degree of curve by applying the fundamental principles of railroad curves. Since all of the angles I with which it is necessary to deal are small, the sines and tangents of such angles can be assumed to be equal. This assumption enables the problem to be simplified and the error involved is well below 0.5 per cent, which is entirely satisfactory, since the graph cannot be read more accurately than this. On this basis then and with the geometric relations shown in Fig. 1, the two following equations may be derived:

$$Y = \frac{D - W}{4 \sin \frac{I}{2}} \quad \text{and} \quad \sin \frac{I}{2} = \frac{C + 12}{2R}$$

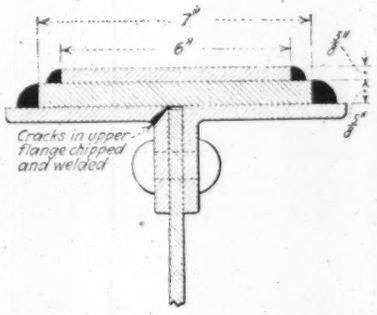
It is these two equations that are plotted as a combination nomograph in Fig. 2. From Fig. 1 it is plain that Y, or the overhang from the center of the coupling, is the only factor to be determined. As an illustrative problem, given a car length of 46 ft., a maximum curve of 10 deg., a car width of 8 ft. and a width of piece of 2 ft., Y will be found to equal 35.5 ft. This problem is illustrated on the nomograph, Fig. 2.

Repairing Railway Bridge Girders by Welding On New Cover Plates

THE New York, New Haven & Hartford Railroad recently utilized arc welding in repairing one of its four-track through-plate girder bridges on the main line at Darien, Conn. Cracking of the top flange angles of the stringers at the root of the angle made the repair necessary. The stringers consist of four 4x3x$\frac{3}{8}$-in. angles and a 36x$\frac{3}{8}$-in. web plate. The repair work consisted in welding on new top cover plates and also in welding the cracks.

After the top of all stringers between the ties had been thoroughly cleaned, the new cover plates of copper-bearing steel were placed on the lower flanges of the stringers preparatory to lifting them into place. The rails were then lifted by jacking from the tops of the floorbeams, and the cover plates raised and slid into position. They were centered and tack welded, after which the rails in that panel were lowered and the process was continued in the next panel.

C-clamps were applied as necessary to hold the cover plates in position. All welding was done from the top. The cracks in the flange angles were cut out into a V with an acetylene torch, after which they were deposited full of weld metal. As shown in the accompanying illustration, filler plates were used at intervals. This was necessary because some of the ties had been redapped several years previously when patch plates had been riveted to the flanges. The filler plates were used to replace the patch plates in order that no new ties would be required.



TYPICAL SECTION THROUGH STRINGER

The filler plates were used only to replace old patch plates for which the ties had been redapped.

The repair work was designed and erected under the direction of E. Gagel, chief engineer, New York, New Haven & Hartford Railroad, with P. B. Spencer, engineer of structures, in direct charge of construction. Track raising was done by railroad company forces and all welding and erecting by the Electric Welding Company of America, Brooklyn, N. Y.

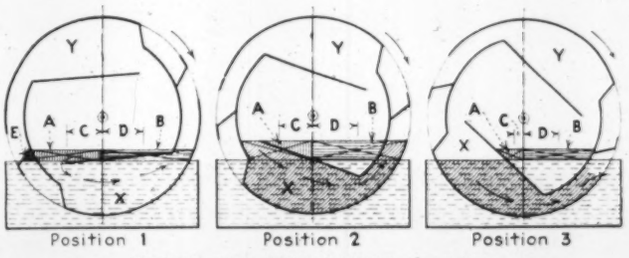
Volumetric Meter for Irrigation and Industrial Uses

IN VIEW of the desirability of measuring irrigation water delivered to individual farms, a special form of meter of the volumetric type has been introduced, and this meter has been applied also with success in industrial plants for such purposes as measuring boiler-feed water and even the hot slimy wastes of a sugar mill. In the design it was considered essential that the device should meet these requirements: (1) low loss of head, as land immediately below irrigation canals cannot be used unless this head is small; (2) capability of being installed as an attachment for a standard weir to record the total flow over the weir; (3) low cost, since the price of water usually is not high enough to justify an expensive installation.

From typical sections of the meter shown in the accompanying drawing it will be seen that there is a revolving drum divided into two buckets, X and Y, and having its lower part submerged in a pan or tank. Power for rotating the measuring drum is derived from the small difference in head of the water on the outside and inside of the drum. Thus, A is the cross-section of water inside the drum and measuring pocket, above the level of water in the pan and at the left of the vertical center line of the drum. At B is the water above that in the pan and at the right of the center line. The distances C and D are from this center line to the center of gravity of A and B respectively. As the moment $B \times D$ is greater than $A \times C$, the drum turns in the direction of the arrow.

In the position at the left, this moment becomes sufficient to lift the lip of the balancing pocket above the surface of the water in the submerging pan, so that the water E drops out of the pocket, giving the drum an impulse to rotate rapidly and causing quick cutoff. At the next position, the inside lip of one of the buckets is just rising through the surface of the water on the interior of the drum, thus cutting out a definite quantity of water, shown by the shaded area. In the third position, the outside lip of the bucket containing the measured water has rotated to a point below the surface of the water in the pan and the bucket is emptying. With further rotation the second bucket will begin to fill.

This meter is the invention of C. Milton Anderson, Salt Lake City, Utah, who also undertakes its manufacture.



METER FOR MEASURING LIQUIDS

A New Welded Girder Splice

By A. W. Schenker
Chief Engineer, Electric Welding Company of America, Brooklyn, N. Y.

WHEN two I-beams are butt welded together end to end and then subjected to transverse bending, the deflections are much larger than for a plain unspliced beam of the same dimensions similarly loaded. Furthermore, the elastic limit is reached very quickly. To offset this it is necessary to build up such a large volume of welding material at the joint that the cost becomes too great to make the operation attractive.

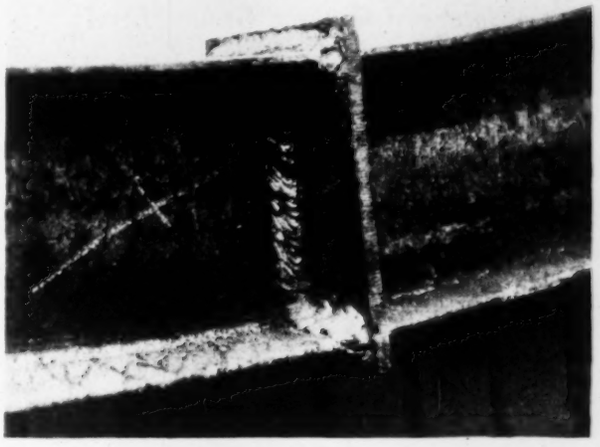


FIG. 1—WELDED INSERT SPLICE PLATE IN BEAM AFTER TESTING

The author has recently developed a splice which seemingly overcomes the foregoing objections. The splice is made by placing a plate between the ends of the beam to be spliced and depositing a fillet weld around the full perimeter of the section on both sides of the plate as shown in Fig. 1. The fillets below the neutral axis are

designed to take the tensile stresses set up in the flange while the fillets above the neutral axis can be made somewhat smaller. Incidentally, the partition plate also acts as a stiffener for the web and the flanges.

In some tests carried out at Columbia University, four 5-in. 10-lb. I-beams were used, two with the welded splice inserted and the other two unspliced for comparison. Loads were applied on two of the specimens at the center and on two at the third points. For loadings at the center the maximum loads for welded and non-welded specimens were respectively 19,900 and 19,100 lb. When loaded at the third point the maximum loads for welded and non-welded were respectively 21,250 and 21,900 lb. Failure was by flexure followed by buckling of the upper flange. No failures occurred in the welds. In Fig. 2 the load deflection curves obtained in these tests are shown.

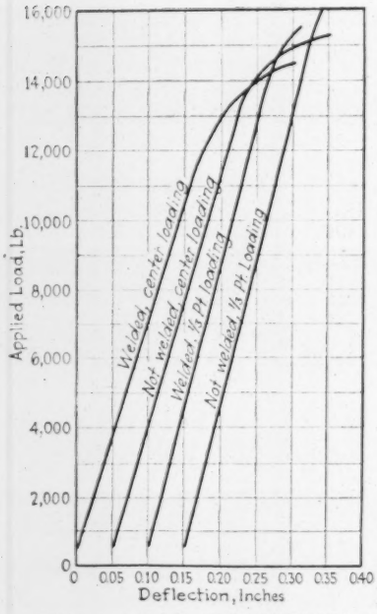


FIG. 2—LOAD DEFLECTION CURVES FOR SPLICED AND UNSPLICED BEAMS

Beams used were 5-in. 10-lb. I's simply supported on 5-ft. spans.

Letters to the Editor

Storage of Water at Ground Level

Sir—The article by my good friend Arthur B. Morrill, "Filtered Water Reservoir Used for Temporary Storage," in *Engineering News-Record* of Aug. 8, 1929, p. 228, prompted me to write on a similar type of storage in use in the Chicago district for several years.

The Chicago Water Department sells water to some thirty municipalities adjoining the city in the Sanitary District of Chicago. These municipalities supplied have a population of more than 300,000. In order to relieve the maximum or peak load on the distribution mains in the city, the department stipulates that these municipalities draw water at the average rate of use. To comply with this stipulation, a number of these municipalities have constructed ground-level concrete reservoirs, to be filled during the night or at periods of low consumption. Booster pumps deliver the water from the reservoir to the distribution system of the municipality when the rate of consumption is above the average. Several of these municipalities for which we are engineers have built such reservoirs in the last few years—namely, Calumet City, 2,000,000 gal. (*Engineering News-Record*, Oct. 1, 1925, p. 540); Niles Center, 500,000 gal.; and Westchester, 500,000 gal. Also, Oak Park has a 6,000,000-gal. reservoir for the same purpose, as have a number of other municipalities.

This method of drawing water from the main at 40 to 50 lb. pressure to fill a surface reservoir involves considerable loss of energy. However, not all water used is involved in this loss, but only the amount above the average rate of consumption. Not only are such reservoirs an advantage to Chicago in relieving the peak load on its distribution mains, but they are also useful to the municipality purchasing water. At the occasional time when turbidity is present, the purchaser can use the reservoir to settle the water. When tastes are present, the retention in the reservoir relieves this condition and the storage is useful as a stand-by for fire protection.

The writer believes that in most cases all the advantages of such storage both in Chicago and the municipality purchasing water can be effected more economically by elevated storage, which would eliminate the energy loss. However, there does seem to be a decided feeling against the appearance of elevated tanks in residential districts in the suburban towns around Chicago. But, Wilmette, a high-class residential town on the north shore, recently installed a 400,000-gal. elevated steel tank and we have not heard any criticism as to its appearance.

J. A. FULKMAN,
Hydraulic Engineer,
Consoer, Older & Quinlan,
Consulting Engineers.

Chicago, Ill.,
Aug. 21, 1929.

Discourtesy to Applicants for Positions

Sir—Articles and opinions have appeared from time to time concerning what is wrong with the engineering profession. May I add my opinion as found from my own experience with one particular phase of the subject?

I am a graduate civil engineer, licensed by the State of New York, and have been engaged in engineering work for twelve years. It has been necessary for me to seek new connections in my profession and to that end I have attempted to make contact with prospective employers through the medium of advertisements. I have not answered these advertisements indiscriminately but rather have chosen them carefully, bearing in mind my qualifications, my ambitions and the prospects offered. Out of a total of twenty advertisements answered in the past three months I have had just two acknowledgments. A good proportion of these advertisers, unfortunately, have used your magazine.

It would seem that when a man answers an advertisement in good faith, common courtesy should compel the advertiser to at least acknowledge the answer. Failing to do so, the advertiser lays himself open to the charge that he is shopping for employees and is not interested in the quality of the applicants. And if our leading engineers and engineering concerns adopt this attitude, then what hope is there for the profession?

If there are any merits in my opinion on the subject, I shall not object to your publishing them. I do, however, ask that I remain anonymous in the proceedings.

ENGINEER.

Waterways List Requested

Sir—As an engineer and contractor engaged on private and public works, I very much appreciate your frank editorial statement of your "Waterway Policy" in your issue of Aug. 15, 1929, p. 241.

In behalf of all "thinking and talking" engineers could you kindly list, first, all waterways "proved to be desirable and economically advantageous." Also second, a partial list of all waterways of "doubtful desirability" or when the "enterprise is a frank experiment." And third, it may well be a waste of mental, vocal and editorial energy to list all waterways afflicted with a "virtual certainty" that they will not pay their costs, and therefore they need not be listed.

I am inclined to suspect that some of your recent correspondents might anticipate your seizing this opportunity of listing the Illinois waterway—the missing link in the Lakes-to-the-Gulf waterway—in your third classification.

There is no doubt that many engineers will avail themselves of your advice and confine themselves to discussions of your first list as soon as it is made public. After the projects enumerated in this list are completed, the second list then comes up for consideration, in the light of past experiences and in compliance with future requirements.

I am offering these suggestions with the hope of securing the united engineering co-operation so desirable in attaining the completion of your first list.

E. R. SHNABLE.

Chicago, Ill.,
Aug. 30, 1929.

News of the Week

Earth Slip at West Abutment of San Gabriel Dam

On Sept. 16 at 1:40 p. m. an extensive earth slip occurred on the side hill near the excavation that is being carried on in the west abutment of the San Gabriel dam, now under construction in California for the Los Angeles County Flood-Control District. The length of the main crack is 400 ft.; the maximum movement was 10 ft., and this was at a point 200 ft. outside the lines of the dam. Estimates place the amount of material within the slip but outside slope lines of the dam as about 100,000 cu.yd. Up to Sept. 20 no slide had yet occurred, but the material was unstable and was to be sluiced down. Since the slip all work at the west abutment has been confined to making the workings safe.

The contract for removing overburden from the foundation for this dam was let for $2.95 per cubic yard, the contract estimate as to the amount of excavation required being 675,000 cu.yd. as the total from both abutments. To date about 650,000 cu.yd. has been taken out, 375,000 from the west abutment and 275,000 from the east abutment. The effect of the recent slide on the construction program has not yet been announced, but district officials are now of the opinion that the excavation necessary to uncover the rock foundation will probably amount to double the 675,000 cu.yd. mentioned in the contract estimate.

Cement Bids Received for San Gabriel Dam

Price of cement for the new San Gabriel dam reached a new low quotation Sept. 10, when the Los Angeles Board of County Supervisors opened bids, after re-advertising for them. C. R. Ross and Felix Kahn offered to supply 3,422,000 bbl. of cement for $5,317,890, delivered at the dam. This is at the rate of $1.54 per barrel and is a saving of more than $400,000 over the former low bid. Ross and Kahn plan to ship the clinker direct to the dam site and grind it into cement in a mill which will be erected there.

Other bids included a joint offering by the Riverside Portland Cement Company and the Colton Portland Cement Company. Their figure was $1.28 per barrel at their mills or $1.56 at Azusa. Fred S. Larson, an international trade councilor and agent for foreign cement, bid 78c. a barrel at Antwerp. With the freight and ocean tariff included, the bid of Larson would be $1.67 a barrel at Azusa. Glen Morgan, local contractor, offered cement at $1.53 at his mill, which is 15 miles from San Gabriel dam at Big Rock, 25 miles from Palmdale. His alternative bid was $1.62 at the dam.

Railroad's Lease to Use Moffat Tunnel Upheld

The lease held by the Denver & Salt Lake Railroad for use of the Moffat Tunnel has been held valid by Judge Symes of the Federal District Court, Denver. Concerning the provisions of the lease limiting the power of the commission to than the railroad the decision contract with parties other also held that the commission's power to contract with subsequent lessees cannot be limited. Following receipt of notice of an increase in rental the railroad filed suit early this year to restrain the commission from increasing the rent or declaring the lease forfeited and asked for a ruling on its validity.

Ambassador and Mount Hope Bridges Near Completion

The last 18-ton beam of the new $20,000,000 Ambassador bridge, linking United States and Canada, was set in place over the Detroit River on Sept. 16. R. G. Cone, resident engineer, announced that unfinished work would be rushed, so the bridge could be formally opened for use by Dec. 1.

Work on the Mount Hope bridge in Rhode Island is also being rushed and it is now expected that the formal opening will take place the latter part of October.

These two bridges, because of defects in the heat-treated wire used in the suspension cables, were dismantled when nearly ready to be opened.

Vicksburg Bridge Pier Pushed Out of Line by Slide

One pier at the east end of the new Vicksburg bridge and pedestals of the approach trestle recently were pushed slightly out of line by the subsidence of a section of the east bank of the Mississippi River close to the bridge. A long period of very high water followed by unusually low water in the river is believed to have caused the subsidence. Construction of the bridge piers is practically completed and erection of the steelwork was under way at the time.

The main river piers are carried down to hard clay, but the bank piers, one of which is involved in the movement, are on piles. The pier next to the bank pier also shows some indication of movement. The construction of these piers was described in *Engineering News-Record*, Sept. 12, 1929, p. 422.

Measurements taken since the first movement indicate that no further movement has occurred for several days, and plans are under way which it is thought will check further disturbance. Erection of the steelwork is proceeding.

Committee on Relief of Traffic Congestion Named

Secretary of Commerce Lamont has announced the appointment of a committee on relief of traffic congestion headed by E. J. Mehren, vice-president, McGraw-Hill Publishing Company, Inc., which will continue the work of the National Conference on Street and Highway Safety and which is supplementary to two other committees recently appointed on maintenance of the motor vehicle and protection of railway grade crossings and major highway intersections.

The committee will study the most

BRIDGING THE SUSQUEHANNA RIVER FOR THE LINCOLN HIGHWAY

Constructing forms for the arch ribs of the new highway bridge across the Susquehanna River between Columbia and Wrightsville, Pa. There will be 28 reinforced-concrete arch spans of 185 ft. each and twenty concrete girder spans of shorter lengths, with a total length for the structure of 7,374 ft. The superstructure and the foundations of the bridge are being built by the Wiley-Maxon Construction Company, of Dayton, Ohio.

advantageous methods for meeting the many different problems of traffic congestion. Information will be developed and made available with respect to the improvement programs now under way in many American cities and applicable alike to the small community and the metropolitan centers.

The first meeting of the committee will be held in Washington on Oct. 10.

Two Water-Works Meetings Held in Middle West

At the Detroit, Mich., meeting of the Central States Section, American Water Works Association, held Sept. 16-20, officers were elected as follows: president, E. E. Bankson, assistant engineer, J. N. Chester Engineers, Pittsburgh, Pa.; vice-president, W. H. Dittoe, chief engineer, Mahoning Valley Sanitary District, Youngstown, Ohio; secretary and treasurer (re-elected), B. J. Lechner; director to represent the section on the board of the parent association, Howell Wright, director public utilities, Cleveland. The next meeting will be held in Youngstown, Pa. The meeting at Detroit was held jointly with the Michigan Conference on Water Purification, except that the latter met separately on one day. Technical proceedings of both organizations are summarized on p. 504 of this issue.

The Wisconsin Section of the association met Sept. 17 and 18 in Kenosha. Filter plant operation, steam electric and diesel pumping and costs, water main laying, elevated storage, the new Kenosha system, the Janesville reservoir and new unit well at Madison were the topics discussed. Leon A. Smith, of Madison, was elected trustee to the parent association and still retains his position as secretary-treasurer of the section.

Indiana Contractor Guilty of Presenting False Claim

George Pontarelli, contractor for a $1,000,000 sewer project in Evansville, Ind., has been found guilty by a Circuit Court jury there of presenting a false claim of $217,000 to the city for quicksand work in the construction of the sewer. He faces sentence of two to fourteen years and a fine of from $10 to $1,000. His conviction opens the way for trials of the mayor, city attorney and members of the board of works, who were also indicted.

Sacramento to Vote on New City Water Supply

By a resolution adopted by the directors of the Sacramento (Calif.) Municipal Utility District, Oct. 10 has been set as the date for a special election at which the voters will have opportunity to decide whether the city shall make an $11,600,000 bond issue to finance a domestic water-supply project. Under the present plans for the Silver Creek project, as it is known, a dam would be built at Union Valley on Silver Creek, a tributary of the American River in the Sierra Nevada, approximately 60 miles from the city of Sacramento, from which a pipe-line conduit would carry the water to the city. It is estimated that for the $11,600,000, 70,000,000 gal. of mountain water may be delivered to the city daily.

Considering 725-Ft. Height for Boulder Dam

An additional height of 25 ft., making a total above bedrock of 725 ft., for the Boulder dam is being considered by the U. S. Bureau of Reclamation, according to a statement made Sept. 23 by Secretary of the Interior Wilbur. The increased height would add 30,000,000 acre-ft. to the water impounded by the dam. Several heights already have been considered, it was explained, and the Denver office of the service will restudy the situation in reference to the proposal to enlarge the dam. A greater height would require revised plans for the entire structure.

It was stated at the department that, under the existing law, the Secretary of the Interior is empowered to adopt the enlarged plan if he deems it advisable.

Henderlite Is Made State Highway Engineer of Louisiana

Harry B. Henderlite, office engineer of the Louisiana Highway Commission since February, will become state highway engineer on Oct. 1 and W. H. Norckauer, temporary state highway engineer since June, will be stationed in Washington, D. C., in charge of the state's federal relations, according to an announcement made by J. M. Nugent, vice-chairman of the commission. J. A. Kinkead, assistant office engineer under Mr. Henderlite, will become office engineer.

Mr. Henderlite, who was formerly assistant city manager of Tampa, Fla., has been with the Louisiana highway department for a number of years, coming to the state as assistant to L. R. Ames, former state highway engineer.

He is the fifth state highway engineer since Governor Long took office on May 21 of last year. James M. Fourmy was the first, his resignation taking place in January. Max Cunningham was second, his term ending with the arrival of Mr. Ames in February. Following the resignation of Mr. Ames in May Mr. Norckauer assumed the duties of the office and has been serving since.

Major-Gen. Hodges Dies

Major-Gen. Harry F. Hodges, U. S. Army, retired, died at his home at Lake Forest, Ill., on Sept. 23, following a heart attack. He was 69 years old and had been on the retired list since 1922.

General Hodges was a native of Boston. Upon graduation from West Point in 1881 he was assigned to the Corps of Engineers. His first important work was on the lock at the Soo, then after a term as instructor at the Military Academy he spent several years on river work on the Ohio and Kentucky. In 1901 he went to Cuba to be chief engineer of the Department of Cuba under General Wood. In 1907 Colonel Hodges went to Panama as assistant chief engineer and member of the Isthmian Canal Commission. It was upon the canal work that Colonel Hodges distinguished himself and for his work there he received the thanks of Congress upon his return to the United States in 1915. During the World War General Hodges commanded the 76th Division in France. For this service he was awarded the Distinguished Service Medal.

Hughes Hearing Final Evidence on Chicago Lake Diversion

The final hearing in the suit of the Lake States to restrain Chicago from diverting water from Lake Michigan opened in Washington Sept. 23 before Judge Charles Evans Hughes. Under the decision of the U. S. Supreme Court handed down last January, diversion was held to be unlawful except to the amount necessary for navigation on the canal connecting Chicago with the Illinois River. The present hearing, a continuation of others held during the spring, is to determine this amount.

Chicago contends that practically the entire amount of the present diversion is necessary, principally to dilute Chicago sewage to prevent injury to the health of those using the canal. Disposal of the sewage by any other method, it is stated, would involve prohibitive expense. The Lake States maintain that one-tenth the present diversion is ample for navigation and that the expense of sewage treatment in Chicago need not be greater than elsewhere.

Increasing Height of Aswan Dam to Be Undertaken Soon

The work of raising the Aswan dam on the Nile River in Egypt is to be undertaken in the near future. This is to be carried out along the lines recommended by the international technical commission composed of Hugh L. Cooper of New York, W. J. E. Binnie of England and H. E. Gruner of Switzerland. Their recommendation calls for adding 10½ meters to the height and building masonry buttresses on the front of the dam. Details of the proposed work were published in *Engineering News-Record*, Feb. 14, 1929, p. 278.

Southern Pacific Celebrates Opening of 96-Mile Line

Official opening of the 96-mile connecting link recently completed by the Southern Pacific Railroad between Klamath Falls, Ore., and Alturas, Calif., was celebrated Sept. 14. This construction provides a new outlet to the East from southern Oregon and northern California, reducing the present rail distance from Klamath Falls to Ogden, Utah, by 211 miles. The line connects at its southern end with the Nevada-California-Oregon Railroad, which passed to Southern Pacific control in 1925 and subsequently was broadgaged as a preliminary step in the improvement program. The new route, including the rehabilitation of the N-C-O and the new construction, required an expenditure of approximately $9,000,000.

Construction work, which began July 17, 1928, included the laying of 73 miles of tangent and 23 miles of curves; ruling grades are 1 per cent east and 2.2 per cent west. Grading involved moving about 1,000,000 cu.yd. of rock and earth, the deepest cut being 36 ft. The line contains three steel girder bridges with a total length of 290 ft. Reference to this improvement program appeared in *Engineering News-Record*, Feb. 23, 1928, p. 307; July 12, 1928, p. 73; and Jan. 31, 1929, p. 181.

National Fire Waste Council to Meet in Washington

Four papers of interest to those engaged in fire-prevention activities will be presented at the semi-annual meeting of the National Fire Waste Council to be held Oct. 1 at the headquarters of the U. S. Chamber of Commerce in Washington. They are: "Equipment and Personnel of Municipal Fire Departments in Relation to Population," by George W. Booth, chief engineer, National Board of Fire Underwriters, New York; "What Fire Prevention Means to Industry," by J. E. Martin, chief engineer, insurance department, U. S. Steel Corporation; "The Fire Department Goes to School" by Sherwood Brockwell, fire marshal, North Carolina, and paper on the fire-prevention activities of state leagues of municipalities, by Morton L. Wallerstein, executive secretary, League of Virginia Municipalities.

Large Welland Canal Lock Opened

Lock No. 8, in the new Welland ship canal, was opened Sept. 12 without ceremony. It is 1,380 ft. long and 80 ft. wide. According to the plans, there will be seven locks of uniform lift, each 46½ ft., to be completed some time next summer. The usable length of these locks is 820 ft., compared with 255 ft. of those of the present canal. Their width is 80 ft., the same as that of No. 8, at the Port Colborne end, compared with 45 ft. of the old locks.

Canadian Highways Meeting Held on Prince Edward Island

The sixteenth annual convention of the Canadian Good Roads Association was held at Charlottetown, P.E.I., Sept. 17-19, with an attendance of 150 delegates from all parts of Canada. O. L. McPherson, Minister of Highways for Alberta and president of the association, in his annual report stated that the mileage of improved highways throughout Canada had been increased during the year by 5,000 miles of gravel, 600 miles of bituminous and 500 miles of concrete, in addition to a large increase in good earth roads.

Subjects taken up at the convention included the construction and maintenance of highways and traffic control, particularly from the point of view of safety. A. D. Ferguson, of the Canadian National Railways Bureau of Economics, speaking on highway financing, cited figures showing that the proportion of provincial highway expenditure derived directly from motor taxation had risen from 42 per cent in 1924 to 54 per cent in 1928.

New officers elected included the following: president, C. L. McPherson, of Alberta; vice-president, H. S. Lougheed, British Columbia. Resolutions were passed reaffirming the belief of the association that the dominion government should give additional financial assistance to various provinces and should carry out investigations and researches into material to be used for dust laying on gravel roads. It was decided to hold next year's convention in Quebec City.

Garbage Dispute to Be Referred to San Francisco Voters

On Sept. 16 the San Francisco Board of Supervisors voted to have placed on the November ballot four questions in an effort to secure from the voters a declaration of policy in the handling of city garbage, a question upon which the council has been unable to reach an agreement. These questions are:

Shall garbage be disposed of by incineration?

Shall the city establish a municipally owned system for the collection of garbage?

Shall the city establish a municipally owned and operated system for the disposal of garbage?

Shall the city and county of San Francisco enter into an agreement with a private individual or corporation whereby the latter will agree to build an incinerator and operate it, with the understanding that the city and county shall be entitled to acquire it upon such conditions as may be stipulated when the agreement is entered into?

This action was adopted by a vote of eleven to seven after a proposal to have placed on the November ballot a measure embodying the fill-and-cover method had been defeated by a vote of thirteen to five.

Pittsburgh Aviation Field to Be Remodeled

Bettis Field, Pittsburgh, Pa., has been purchased from the Aircraft & Airways of America by the Curtiss Airports Corporation, it is announced, and will be improved to provide adequate ground facilities for a flying service base and transport company terminal.

Plans for the improvement include grading, which involves the removal of 425,000 cu.yd. of earth, and an artificial drainage system. These improvements will be augmented by hard-surface runways leading from a concrete apron spread under the terminal building canopies.

All present buildings at the field will be wrecked so that a complete remodeling of the airport may be effected. Two large hangars will be constructed immediately, together with a central terminal building, where offices will be established for a weather bureau, a post office, an express company, and telegraph and telephone companies. The building will include also offices for sale of transport and sightseeing tickets, a radio station and passenger waiting rooms. Control over arriving and departing planes will be maintained from a tower rising from the terminal building. The entire unit will be of fireproof construction.

New England Water Works Assn. Meets at Portland

Announcement was made at the Portland meeting of the New England Water Works Association last week of the election to honorary membership of Sir Alexander Houston, director of water examinations, Metropolitan Water Board, London, England. The Dexter Brackett medal, given each year to the author of the paper read before the association which is judged to be the best, was presented to F. W. Dean, engineer and architect, Boston, Mass., for his paper on "Pumping Station Practice," published in the *Journal* of the New England Water Works Association for June, 1928.

The election tellers announced the adoption of the ticket sent out by letter ballot some weeks ago: president, Robert Spurr Weston, consulting engineer, Boston; first vice-president, George H. Finneran, superintendent water service, Boston; second vice-president, George C. Brehm, city engineer and director of public works, Waltham, Mass. The following continue in office: secretary, Frank J. Gifford, Dedham, Mass.; treasurer, Albert L. Sawyer, Haverhill, Mass.; editor, Prof. Gordon M. Fair, Cambridge, Mass. The secretary reported a membership of 830 in all classes. Invested funds of the association total some $15,000.

Besides the technical papers and committee reports dealt with on p. 502 of this issue, there were various entertainment features. The Portland Water District provided an automobile trip to its water-works shops after a clam

chowder luncheon there, and to some of its standpipes to see painting work in progress. The Water Works Manufacturers Association tendered the members and guests of the N. E. W. W. A. a steamboat ride on Casco Bay, with a clambake on shore; also, on Thursday evening, a dinner dance. The associate members of the association made the usual exhibit of water-works materials and appliances.

Court Approves Rio Grande Conservancy Bonds

A bond issue of $8,700,000 for flood control, irrigation and drainage of 124,000 acres of seeped lands and for river regulation by the Middle Rio Grande Conservancy District has been approved by the state Supreme Court of New Mexico in a suit brought to test the validity of the bonds. The total cost of the project will be about $10,300,000, of which Congress has already appropriated $1,600,000 for the work in that part of the district which consists of Indian lands. There will be a large rockfill storage dam and four diversion dams on the Colorado River at the heads of the main canals. The lands of the district were irrigated to a large extent under the ownership of the Spaniards, the Mexicans and the Indians, but great areas have become waterlogged, swampy and alkaline due to the excessive seepage and irrigation waters. J. L. Burkholder is chief engineer of the district.

Montreal Construction Company in Voluntary Liquidation

The P. Lyall & Sons Construction Company, of Montreal, which has for some time been in financial difficulties, has gone into voluntary liquidation, and G. S. Currie has been appointed provisional liquidator. The company has a number of large contracts on hand, including one for the Republic of Colombia, South America, involving $20,000,000, which has been delayed owing to a change of government. A contract with the dominion government for the construction of two sections of the Welland Canal, now almost completed, resulted in a claim by the contracting company for $750,000 which is disputed by the government.

Davenport, Iowa, to Vote on Purchase of Water-Works

By a vote of 4 to 3 the city council of Davenport, Iowa, has decided to call a special election on Oct. 12 to decide if the city shall purchase the plant of the American Water Works & Electric Company, which now supplies the city with water, and continue the works as a municipally operated project.

It is claimed by proponents of the plan that the city can reduce rates and still amortize the purchase cost out of earnings within 35 years.

Brief News

THE HUDSON RIVER BRIDGE between Fort Lee, N. J., and Fort Washington Park, N. Y., marked the second anniversary of its start on Sept. 21 by the completion of the footbridge from tower to tower, the last operation preparatory to cable spinning.

FEASIBILITY OF A SUBWAY under Market St. from Valencia St. to the Embarcadero, San Francisco, will be determined by the city engineer's office of that city, which has been instructed by the board of supervisors to make a survey and an estimate of the cost.

A SEWAGE-DISPOSAL PLANT for Spartanburg, S. C., is assured by a 3½ to 1 favorable vote of the electorate for a million-dollar bond issue to pay the cost. The plant will serve a newly created sewerage district which includes near-by territory.

THE FIRST RETURN TRIP over a regularly ballasted track to Churchill over the Hudson Bay Railway was completed on Sept. 18. Officials report the line to be in good condition and available for passenger traffic.

STEEL FOR THE NEW WALDORF-ASTORIA HOTEL in New York City will be furnished by the McClintic-Marshall Company, the contract calling for 25,100 tons for the superstructure and 2,000 tons for the substructure. The cost of the steel will be in excess of $2,250,000. Steel erection is scheduled to begin about Jan. 1, 1930. The new hotel will cover the block bounded by Park and Lexington Aves. and 49th and 50th Sts.

NEW WHARVES and quay walls between the coal dock and bureau wharves at Three Rivers, Que., will be constructed by the Northern Construction Company and J. W. Stewart, of Montreal, the contract having been awarded to them by the harbor commissioners for $2,660,535.

A NEW PLATE MILL, to cost $1,500,000, has been started at Gadsden, Ala., by the Gulf States Steel Company. Altogether the construction program of the company at this place calls for the expenditure of $5,000,000, and it is expected that 400 men will shortly be at work on it. The contract for a new sheet mill will be let in October.

USE OF NITRO-CELLULOSE X-RAY FILM in homes, hospitals, schools, and certain other institutions in New York State is forbidden by an amendment to the state sanitary code which went into effect Sept. 15. This supplements the order prohibiting the sale and distribution of such films noted in our issue of July 18, p. 114.

A SEVENTEEN-BUILDING PROGRAM for the University of Texas, to cost about $8,500,000, to provide for a quarter-century's expansion and to be completed within two years after it is undertaken, is now being mapped out by the regents of the university.

SWOLLEN WATERS of the Saugeen River wrecked a portion of the W. B. Foshay Company's dam at Walkerton, Ont., on Sept. 17. The section which collapsed is about 40 ft. long. Last April, during unprecedented high water, a section of the retaining wall of the same dam collapsed from the same cause.

MONTREAL'S LARGE SEWERAGE PROJECT, the construction of the Back River collection system, has been started. The first unit is now being constructed and it is expected work on the main trunk will commence early next year. Upon completion of the collector system and the accompanying sewage treatment plants, the Riviere des Prairies, or Back River, will be free of sewage pollution, to which it is now exposed by virtue of the existence of nine sewers discharging into the river.

WORK ON THE GREAT DAM for the reservoir in the Silent Valley for the Belfast (Ireland) Water Board has reached the stage where a trench has been dug to rock bottom over every inch of the foundations, thus dispelling all doubts as to the feasibility of the project. When the work is completed an adequate supply of excellent water will be assured to Belfast and the surrounding district for many years to come. It is expected that the total cost of the work will approximate £2,000,000 ($9,750,000).

Los Angeles Planning Structure to Replace St. Francis Dam

Plans for a dam and storage reservoir of 36,000 acre-ft. capacity in the Chatsworth district to replace the St. Francis dam and reservoir have been announced by H. A. Van Norman, chief engineer and general manager of the Los Angeles Department of Water and Power. The new dam will be located near the present Chatsworth reservoir, which is a part of the Los Angeles water-supply system and is situated about 25 miles south of the former St. Francis dam site. The cost of the new structure will be between $4,000,000 and $5,000,000, it is estimated.

Following the report of its consulting engineers, Louis Hill and A. J. Wiley, that this was the best section in which to construct the reservoir, the water and power commissioners authorized issuance of $1,000,000 in short-time notes to finance preliminary construction work. Work on the new structure will begin as soon as the plans are sanctioned by the state engineer's office, Mr. Van Norman said.

Survey Water Resources of South Platte River

A joint survey of water resources of the South Platte River is being made by M. C. Hinderlider, state engineer of Colorado, and Robert Follansbee, district engineer of the U. S. Geological Survey, in connection with the tentative program of the Denver water commissioners to construct a dam at Two Forks. A preliminary permit, recently granted by the Federal Power Commission, which allows three years' time for exploratory work and contemplation of development possibilities, covers a 79,000-hp. power project. Tentative plans contemplate the sale of power generated to retire outstanding water bonds and furnish the city and county of Denver with permanent revenue.

California Pipe Line Started

The Coast Counties Gas & Electric Company, Santa Cruz, Calif., has started construction in its southern territory of a 10-in. transmission line extending from the present 20-in. line of the Pacific Gas & Electric Company east of Gilroy to Watsonville. The connection to the Pacific Gas & Electric Company's lines is of a temporary nature, as the Coast Counties company has an application before the California Railroad Commission for permission to build its own 20-in. line from the Kettleman field to Contra Costa County, with a branch line from Los Banos through Pacheco Pass to serve its southern territory.

In its northern territory, new construction will consist of a gas transmission line extending from the company's present 6-in. transmission line in Crockett to the vicinity of Pittsburg.

The pipe to be used in the southern territory will consist of 110,000 ft. of 10-in. main transmission and 98,000 ft. of 4- and 6-in. lateral transmission; in the northern territory, 42,000 ft. of 12-in. and 78,000 ft. of 20-in. main transmission and 49,000 ft. of 4½-in. lateral transmission will be laid. Sanderson & Porter are construction engineers for the Coast Counties company, and R. J. Chapman, of the firm's San Francisco office, will be in charge.

Water-Power Rights Granted to Canadian Utility

An ordinance authorizing work costing nearly $50,000,000 has been issued by the Public Service Commission of the Province of Quebec. The ordinance affects the work of the Beauharnois Light, Heat & Power Company, which proposes to develop 300,000 horsepower of electric energy. Authority is given to construct a canal between Lake St. Francis and Lake St. Louis, to erect a plant at the end of the canal to divert water from the St. Lawrence River and to carry out other works at points on the shores of the St. Lawrence River. Work on the construction of the diversion channel is now under way.

WASHINGTON NOTES

By Paul Wooton
Washington Correspondent

Army Engineers Reorganization and the New Chief—Floodway Decision Held Up by Louisiana

APPOINTMENT of Brig.-Gen. Lytle Brown to be Chief of Engineers is in accordance with the President's desire to secure for that place a man of the Goethals type who will have an extended period of duty prior to reaching the retirement age. General Brown will not retire until Nov. 22, 1936, thereby making it possible for him to serve continuously as Chief of Engineers for more than seven years. The President is understood to believe that a problem of the magnitude of the Mississippi River flood-control project must be continued under the same direction for a longer period than would have been possible had some of the higher-ranking colonels been selected. General Brown, according to those who know him, possesses the same determination and faith in his convictions for which General Goethals was noted. While his service has been characterized by frequent differences of opinions with his superiors, this has in no way approached the point of insubordination, but rather has demonstrated his capability for leadership.

Colonels Passed Over

In the appointment of General Brown the following colonels were passed over: Herbert Deakyne, Charles W. Kutz, William B. Ladue, William J. Barden, E. H. Schulz, Harry Burgess, George M. Hoffman, Sherwood A. Cheney, Harley B. Ferguson and William P. Wooten. As a result of this appointment it is expected that most of these colonels will apply for retirement. To pass over so many officers in the selection of a Chief of Engineers departs radically from precedent; usually promotion has been strictly on a basis of seniority. There have been cases where two or three men at the head of the list have been passed over, but never since the appointment of Gen. A. A. Humphries in 1866 has there been such a departure from the regular order.

Decentralization

Speculation is current in army circles as to the effect that the appointment of the special assistants to the Chief of Engineers will have on the continuance of the Mississippi River Commission. General Jackson, president of the commission, is charged with the responsibility of supervising the execution of the flood-control program in the field of operations. If the President carries out his intention of delegating an engineer officer to the lower river section to assume direct control of the work, it is argued that the Mississippi River Commission will be rendered unnecessary except in an advisory capacity. There is also some doubt as to just how far the Chief of Engineers can go in delegating his authority to a special assistant in the field. Under the existing law, the approval of the Chief is necessary before a contract for construction work can become valid. It is also held that the flood-control act specified that the work should be carried out under the direction of the Chief of Engineers and the Secretary of War. Whether or not this authority can be delegated is open to question. It is the general opinion, however, that the execution of the flood-control program can be prosecuted with perfect propriety through the President's plan of decentralized control. The location of a special assistant to the Chief of Engineers in some center in the lower valley would make the direction of the work more responsive to local sentiment.

A Possible Consolidation

Work on the Ohio and the Missouri can be carried out with very little change by combining the Western and Central divisions of the Corps of Engineers, which jointly have charge of these projects at present. General Jackson, president of the Mississippi River Commission, is also the division engineer for the Western Division. There always has been some doubt that he could find the necessary time to supervise the work of the division properly without neglecting the affairs of the commission. It is therefore believed that the two divisions will be combined by naming Colonel Ferguson, who is at present in charge of the Central Division in Cincinnati, as the chief of both of them.

In some official quarters the opinion is expressed that the President's plan will not decentralize the work of the Engineers any more than it is at present. Power was centralized more in Washington under General Jadwin than is usually the case, it is pointed out, because of the importance of formulating the flood-control program and directing the initial stages of its execution. General Jadwin was forced to assume more active control of the work than the Chief usually does over field operations, it is said, because some of his assistants were not inclined to stick to the adopted flood-control plan. The President must intend that General Brown should have the final responsibility for the work, it is pointed out, or he would not have made such a careful search for an army officer of unusual ability to fill the position of Chief of Engineers.

Floodway Stay Delayed

Difficulty is being experienced in persuading Senators and Representatives from the lower Mississippi Valley to assume responsibility for the delay in constructing the west bank floodways in Louisiana. The President has asked for such a statement in writing, but the two Representatives from the city of New Orleans have declined to sign. Three other Louisiana legislators are hesitating. The remaining five have assured the President that they are perfectly willing to assume their part of the responsibility while further examinations and studies are being made. All of the Arkansas delegation has signed, but the Mississippi Senators and Representa-

tives are not ready to follow suit. Former Senator Leroy Percy, who is a resident of the Yazoo delta, a section greatly interested in the diversion, is expected to use his influence to secure the acquiescence of the Mississippians. Experience with the prolonged high water this year has convinced him that the diversion must be controlled so as to begin to operate at a stage much below that of the Jadwin fuseplug.

Representative Reid, of Illinois, chairman of the flood-control committee, is outspoken in his disapproval of the President's proposal. The responsibility which some of the Senators and Representatives are taking upon themselves is likely to be a very serious one, he thinks, if the delay in having the floodways ready should make it impossible to avert another disaster like that of 1927.

More Government Buildings

Preliminary plans for construction of four more buildings in the government's housing program are so nearly complete that Congress is expected to authorize construction at the regular session in December. The new group comprises the Interstate Commerce Commission, Independent Offices, Department of Justice and Labor Department buildings that will be located in the triangle south of Pennsylvania Ave. Tentative sketches which will serve as a basis for the estimates to be submitted to Congress have been presented to the Commission of Fine Arts for approval and are now being examined by the board of architectural consultants. Construction of the new Commerce Department and Internal Revenue buildings is reported to be right up to or ahead of schedule.

Personal Notes

GEORGE S. DAVISON, past-president of the American Society of Civil Engineers and one of the outstanding men in the oil industry in the United States, has resigned as president of the Gulf Refining Company and as vice-president of the Gulf Oil Corporation and has severed his connection with numerous other allied industries in order to take active management of the Davison Coke & Iron Company, which he founded this year and of which he is president.

EDWARD GAGEL, chief engineer of the New York, New Haven & Hartford Railroad for the last sixteen years, will retire from active service on Oct. 1 at his own request. His railroading career covers 56 years, 47 of which have been with the New Haven road.

MONTGOMERY B. CASE, engineer of construction for the Port of New York Authority on the Hudson River bridge, has assumed similar duties in connection with the Staten Island bridges, formerly in charge of the late William J. Boucher.

R. B. BALL, formerly chief engineer of the Coast Lines, Atchison, Topeka & Santa Fe Railroad, with headquarters in Los Angeles, has been made assistant chief engineer of the Santa Fe system, effective Sept. 1, with headquarters in Chicago. M. C. BLANCHARD, who has been chief engineer of the company's Western lines with headquarters in Amarillo, Tex., succeeds Mr. Ball in Los Angeles as chief engineer of the Coast Lines.

DANA E. KEPNER, sanitary engineer for the State of Colorado under the board of health, has resigned and will become district manager for the Pacific States Cast Iron Pipe Company, which will open an office in Denver.

CHARLES PUTNAM DUNN, formerly chief engineer of the Portland Electric Power Company, has been appointed chief engineer of the Alcoa Power Company, Ltd., a subsidiary of the Aluminum Company, which is building a power plant on the Saguenay River.

M. M. WATERMAN, who since April, 1928, has been field engineer in charge of an exploration party in interior Honduras locating reservoir sites for the Standard Fruit & Steamship Company, has returned to the Arkansas Commission of State Lands, Highways and Improvements as resident engineer in charge of a state force project between Paragould and Lake City. Mr. Waterman was formerly employed by the Florida State Road Department as project engineer on construction in western Florida.

NORMAN H. WARREN, since 1921 general manager of the Dominion Bridge Company, Ltd., with headquarters in Montreal, has recently been elected vice-president and general manager of that company.

S. L. VAN NORDEN, formerly assistant engineer of Glen Ridge, N. J., has joined Harold E. Allen, civil engineer, of Rutherford, N. J., as associate engineer. He will be in charge of design and construction of municipal and special concrete work.

B. D. KEATTS, formerly assistant engineer for the bridge department of the Missouri Pacific Railroad, is now inspector for the Chicago district office of the Stone & Webster Engineering Corporation.

J. E. FARQUHARSON, of Canajoharie, N. Y., who has recently been supervising engineer on construction with William A. Smith, consulting engineer, of Tuckahoe, N. Y., has been appointed chief engineer for the Wood Motor Parts Corporation, of Neola, W. Va. Mr. Farquharson was formerly assistant engineer of the New York State Highway Department on Long Island.

JAY F. GIBBS, formerly city engineer of Ferndale, Mich., has been elected manager of the village. He succeeds Carl H. Peterson, resigned.

WALTER MCCULLOH, who has been a consulting engineer in Niagara Falls, N. Y., since 1897, has retired from private practice to become engineer of construction and maintenance in the Niagara Falls City Department of Education.

Society Calendar

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Washington; annual meeting, San Antonio, Tex., Nov. 12-15.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; annual convention, Minneapolis, Minn., Sept. 30-Oct. 4.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; fall meeting, Boston, Mass., Oct. 9-11.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION, Chicago; annual meeting, New Orleans, La., Oct. 15-17.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Louis; annual convention, Philadelphia, Pa., Oct. 14-18.

ASPHALT PAVING CONFERENCE, New York City; annual meeting, West Baden, Ind., Oct. 28-Nov. 1.

CONFERENCE OF STATE SANITARY ENGINEERS, Washington; annual meeting, Minneapolis, Minn., Sept. 28-30.

INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS, Chicago; annual conference, Jacksonville, Fla., Oct. 14-16.

NATIONAL PAVING BRICK MANUFACTURERS ASSOCIATION, Washington; annual meeting, Chicago, Ill., Dec. 4-6.

NATIONAL SAFETY CONGRESS, Chicago; annual meeting, Chicago, Sept. 30-Oct. 4.

SOUTHWEST WATER WORKS ASSOCIATION, Fort Worth, Tex.; annual convention, Tulsa, Okla., Oct. 14-16.

AMERICAN ASSOCIATION OF ENGINEERS will hold its annual meeting Oct. 11-12 at Chicago. This is not a convention or general rally of members, but simply a session to comply with the regulation of the new constitution and bylaws recently adopted. The board of directors meets on the above dates and a dinner meeting will be held the first evening.

THE NEW YORK SECTION of the American Water Works Association will hold its fall meeting in Glens Falls, N. Y., Oct. 3 and 4. On the program are papers on "Relation of the Interior Condition of Water Mains to the Coefficient of Roughness," by Arthur T. Clark, chief engineer, Supervising Engineers, Community Water Service Company, New York City; "Correlation of Water and Fire Departments," by Joseph N. Sullivan, chief, fire department, Utica, N. Y.; "Changing From a Flat Rate to a Meter Basis in a Municipal Plant," by Alexander Orr, superintendent, board of water commissioners, Gloversville, N. Y., and "The Many Angles of Installing a Water-Works System," by William T. Field, consulting engineer, Watertown, N. Y.

Obituary

J. D. BLACKWELL, for two years city engineer of Seattle, died suddenly at his home in that city on Sept. 5, at the age of 59 years. Mr. Blackwell had been engaged in civil engineering in Seattle for twenty years and was a former president of the Northwest Society of Engineers.

FREDERICK J. SCHLEGEL, 53 years old, of the contracting firm of Schlegel & Roehm, one of the largest in Indianapolis, Ind., died recently at his home after an illness of several months. He had been a resident of Indianapolis 39 years.

JOHN LUCEY, of Yonkers, N. Y., a civil engineer, died suddenly on Sept. 16. He was 45 years old. Mr. Lucey, who was a graduate of New York University, had spent the last twelve years in railroad engineering work in Mexico and Central America.

Construction Equipment and Materials

Building Products Firms Merge

Amalgamation of the Insulite Company and the United States Gypsum Company was announced Sept. 19 by F. L. Avery, president of the United States Gypsum Company. It is stated that the identities of the two companies will not be affected, as both will continue to operate under separate management. Insulite products, however, will be distributed by both organizations.

Although newspaper reports stated that the Johns-Manville Corporation was also concerned in the merger, this has been denied by both the United States Gypsum Company and the Johns-Manville Corporation.

Syracuse Forbidden to Operate Chlorinating Apparatus

Further operation of a chlorinator purchased from the Paradon Manufacturing Company by the city of Syracuse, N. Y., has been forbidden by a decision by Judge Bryant of the U. S. District Court for the Northern District of New York dated Aug. 31. The suit was brought by Wallace & Tiernan Company, Inc., on the ground that the apparatus infringed a patent on the Ornstein process of antisepticizing water, under which Wallace & Tiernan are the sole licensees.

New Developments

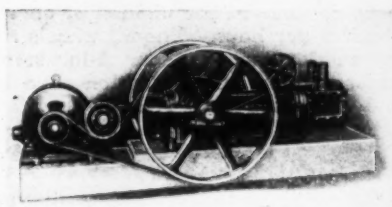
Steel Armoring for Pavements Subject to Heavy Wear

Maintenance expense on sections of asphalt and concrete pavements subject to unusually severe service should be greatly reduced by the use of Pavegard, a steel armoring developed by the Blaw-Knox Company, Pittsburgh, Pa. This is not to be confused with the conventional steel reinforcement, for it is placed at the surface to provide a wearing surface and to prevent the cracking of concrete and the waving of asphalt. Pavegard is made up of steel strips placed together on edge in a regular pattern or mesh, the sections being held together by tie-rods. It is assembled on a concrete, asphalt or other solid base, after which the topping or finishing surface is placed and rolled in the case of asphalt, or troweled and screeded if concrete. Pavegard has been in use for several years in England and Continental Europe. The illustration shows it being placed at a busy bus station in Chicago.

PLACING PAVEMENT ARMORING IN ASPHALT STREET

Roller Bearings Used in Air Compressor

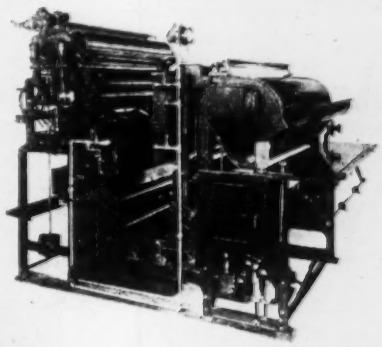
In the single horizontal straight line series of stationary air compressors with capacities from 100 to 300 cu.ft. per minute manufactured by the Worthington Pump & Machinery Corporation, Harrison, N. J., Timken roller bearings are now used on the main crankshaft journals. This eliminates the necessity of bearing adjustments in maintenance. Other features of the compressors include oil rings mounted on the crankshaft to return surplus oil to the oil-tight crank case, feather valves made of light strips of steel which permit the passing of air by flexing against a curved guard, an automatic starter and a pressure regulator. The compressor can be driven by belt or rope drive, or a synchronous motor can be mounted directly on the crankshaft.



AIR COMPRESSOR WITH BELT DRIVE

Improvements Made in Blueprinting Machine

Changes in the system of washing prints and the addition of a reverse gear are features of the new Peerless model 30 continuous blueprinting machine, made by the C. F. Pease Company, Chicago, Ill. This is designed to produce blueprints, negative prints and blue and brown line prints in a continuous strip. In operation, tracings are laid face up on a continuous roll of paper feeding at the front of the machine, and are carried upward around a semicircular segment of curved French plate glass, past a bank of arc lamps. After the exposure has been made the tracings are automatically returned into a tray at the front of the machine, while the prints on the continuous roll of paper are carried through successive operations of washing, developing and drying. The machine is gear driven throughout and has a speed range varying from 4 in. to 12 ft. per minute. It is driven by a variable-speed ¼-hp. motor through an automotive type gear box with two forward speeds and a reverse. The reverse gear, not hitherto provided, permits the operator to withdraw tracings or run back the leader roll whenever desired, without inconvenience.



IMPROVED BLUEPRINTING MACHINE

Prints are washed both before and after the developing process by specially designed jets directing a pressure spray over the entire front and back surface of the paper. While designed particularly for long-run, high-speed production, it is possible to produce single prints when so desired.

Elevating Grader Redesigned to Lengthen Belt Life

Recognizing the fact that the repair and replacement of damaged belts has always been a considerable item in the maintenance of elevating graders, the J. D. Adams Company, Indianapolis, Ind., has brought out a new and improved Stroud heavy-duty elevating grader using a 42-in. belt, in which special attention has been paid to the prolongation of belt life. The belt carrier has been made exceptionally sturdy and rigid so that the belt will always run true on the carrier. Heavy Z-bar steel is used for the carrier sills, with the roller boxes mounted inside and beneath the Z-bars, so as to be fully protected from dirt. The carrier is so designed that the edges of the belt cannot scrape the floorboard bracket. A third idler roller has been placed underneath the carrier near the drum to prevent the belt from sagging. Another new feature is a long steel shoe placed beneath the drum to prevent it from coming in contact with wagons or trucks. At its lower end the belt is protected by guards which prevent stones

ELEVATING GRADER WITH REAR WHEEL DRIVE

and roots from catching between the belt and the flareboards. A boxlike shield prevents dirt from being scraped into the upper pan or cathole.

Other improvements include an all-steel tongue, a wider range of adjustment for the carrier, improved plow features and a power take-off. The latter is furnished as an extra, the grader being equipped regularly to drive the carrier from the rear axle. By means of the power take-off the carrier can be driven by a flexible drive shaft and chain driving mechanism at the center of the grader, utilizing power taken directly from the tractor. The new grader, complete with 3-ft. carrier extension furnished as regular equipment, weighs approximately 17,500 lb.

Resistant Paint Made in Colors

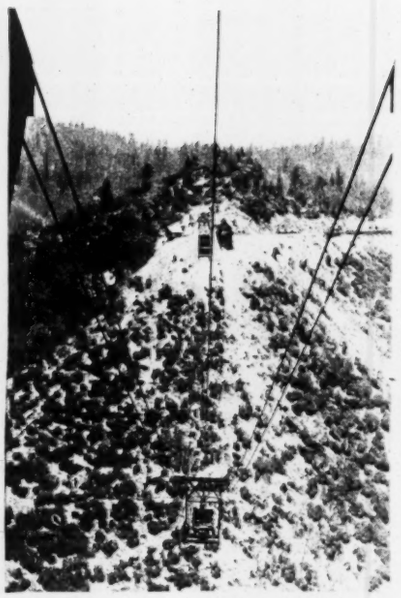
Lacquers in a series of colors for use where an oil-resistant, highly protective, durable and flexible insulating coating is required are now being produced by the General Electric Company, Schenectady, N. Y. It is claimed that these paints are superior to ordinary protective paints in that they are more easily applied, dry faster, have a more pleasing appearance and are less affected by high temperatures. They adhere to any surface, including galvanized iron and aluminum, and have a dielectric strength greater than commonly used paints. Five colors are available — red, blue, brown, green and aluminum. Application may be by brushing, spraying or dipping, the lacquers drying in 30 minutes and hardening in approximately ten hours to a hard, smooth finish which is not brittle. No priming or sizing is necessary. Among the uses for which the new paints are recommended are the sealing of joints in gas mains and the painting of structural iron and steel, fire hydrants and machinery.

Excavator Made in ¾-Yd. Size

A new model excavating machine with a capacity, as a shovel, of ¾ cu.yd., which can be converted into a crane, dragline, trencher or skimmer, is now being produced by the Byers Machine Company, Revenna, Ohio. It is of the full-revolving type and is patterned

¾-CU.YD. GASOLINE SHOVEL

after other Byers models, using the independent cable crowd. Power is provided by a 75-hp., six-cylinder motor with cylinders 4⅜x4¾ in., which drives through a silent chain to the jackshaft mounted in Timken roller bearings.



HIGH-SPEED CABLEWAY CARRIES HEAVY LOADS

What is said to be the largest electric cableway in this country spans a canyon near Camino, Calif., to carry lumber between a loading point on one side and a mill on the other. The single loaded carrier transports a rail car with a maximum load of 12 tons (gross weight 29 tons) a distance of approximately 2,700 ft. at a maximum speed of 1,800 ft. per minute, or about 20 miles per hour. The 32 wheels of the carrier run on four 2-in. steel cables. The endless traction rope is of 1 in. diameter. Power is supplied by two 225-hp. General Electric motors.

Business Notes

INTERNATIONAL DERRICK & EQUIPMENT COMPANY, Columbus, Ohio, has purchased the capital stock and manufacturing plant of the Boykin Machinery & Supply Company, Beaumont, Tex. This company will be reorganized as a subsidiary under the name of the International Derrick & Equipment Company of Texas, with Harry M. Runkle as president; B. Boykin, Jr., vice-president and general manager; and L. L. Powell secretary and treasurer. A number of new buildings will be added to the present plant.

INDEPENDENT PNEUMATIC TOOL COMPANY, Chicago, Ill., has elected Ralph S. Cooper president to fill the vacancy caused by the death of John D. Hurley on Aug. 15. Mr. Cooper has been a vice-president of the company since 1917 and general manager in charge of all departments since 1921. Neil C. Hurley was elected a member of the executive committee and Raymond J. Hurley a director.

SULLIVAN MACHINERY COMPANY, Chicago, Ill., has appointed Harry W. Oliver manager of its San Francisco office, succeeding the late Ray P. McGrath, whose death was noted last week.

HYATT ROLLER BEARING COMPANY, Newark, N. J., has advanced H. O. K. Meister from general sales manager to assistant general manager.

LINDE AIR PRODUCTS COMPANY, New York City, has opened a new plant in Erie, Pa., to supply the local demand for oxygen used in welding and cutting.

PARADON MANUFACTURING COMPANY, Arlington, N. J., has appointed William H. Fulton chief engineer of the company.

H. D. CONKEY & COMPANY, Mendota, Ill., is building an addition to its plant which will double its manufacturing capacity.

New Publications

Fireproofing — AMERICAN INSTITUTE OF STEEL CONSTRUCTION, INC., New York City, is distributing a 14-p. booklet, "Fireproofing Structural Steel," discussing the relative values of different materials used for the fireproofing of steel structures.

Chain Drives—RAMSEY CHAIN COMPANY, INC., Albany, N. Y., has published a new catalog of 85 pp. on the subject of chain drives for power transmission. This contains many technical data for use in designing chain drives.

Diesel Draglines—PAGE ENGINEERING COMPANY, Chicago, Ill., in a 27-p. illustrated bulletin describes in detail the Page diesel engine, built and designed to meet the unusual conditions of dragline service. Descriptions and operating dimensions of diesel-powered draglines are included.

Measuring Instruments—BROWN INSTRUMENT COMPANY, Philadelphia, Pa., has published a 90-p. illustrated catalog of the many types of measuring instruments manufactured by the company for use in power plants, irrigation works, waterworks and for general industrial service.

Blowers and Compressors — DELAVAL STEAM TURBINE COMPANY, Trenton, N. J., has published catalog F of single and multi-stage centrifugal blowers and compressors for all pressures up to 100 lb. per sq.in. The mechanics, thermodynamics and physical properties of gases are covered in concise form in a section of the catalog.

Airport Lighting—WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, East Pittsburgh, Pa., devotes special publication 1854 to a discussion of equipment for the night illumination of airports. Recommendations of the U. S. Department of Commerce are given, together with a diagram illustrating the lighting installation at the Newark airport and detailed descriptions of Westinghouse products for this purpose.

Building Specialties—UNION STEEL PRODUCTS COMPANY, Albion, Mich., describes in catalog 229 many types of bar clips, spacers and chairs; form spacers; anchor slots; sleeper bases and other accessories for use in concrete and steel building construction.

Iron and Steel Alloys — INTERNATIONAL NICKEL COMPANY, INC., New York City, has issued recently several publications. These include a 4-p. leaflet 201-a "An Introduction to Nickel Cast Iron," an 11-p. booklet: "Properties and Applications of Nickel and Nickel-Chromium Cast Iron," a buyers' guide listing a large number of companies producing and distributing nickel alloy steel products, and a pamphlet telling how the use of nickel cast iron has solved problems in the production of compressor stuffing boxes, pile hammer cylinders, hoist brake drums and other castings.

Costs and Contracts

E. N.-R. Index Numbers

Cost			Volume		
Sept. 1,	**1929**	**207.57**	**August,**	**1929**	**290**
Aug. 1,	1929	205.91	July,	1929	320
Sept. 1,	1928	207.29	August,	1928	306
Average,	1928	206.78	Average,	1928	287
Average,	1927	206.24	Average,	1927	263
1913		100.00	1913		100

This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week of Sept. 26, with some comparisons, total as follows:

(In Thousands of Dollars)

	Sept. 26, 1929	Sept. 19, 1929	Sept. 27, 1928
Building:			
Industrial	$5,902	$5,517	$6,315
Commercial	81,114	50,105	34,120
Streets and roads	8,198	12,388	7,023
Other eng. constr.	13,081	7,062	22,283
Total	$108,295	$75,072	$69,741
Total, all classes, Jan. 1 to Sept. 19:			
1929			$3,221,558
1928			2,682,825